Penthera 301: iOS SDK Beyond the Basics

iOS SDK 4.1

December 8, 2020

Advanced development documentation for Penthera iOS SDK 4.1. Covers intermediate and advanced topics, as well as extended SDK features.

Table of Contents

Intermediate Topics

Configure Device-level Download Behaviors: iOS

The SDK obeys several device-level behavioral settings. You may access and configure these settings through the VirtuosoSettings instance:

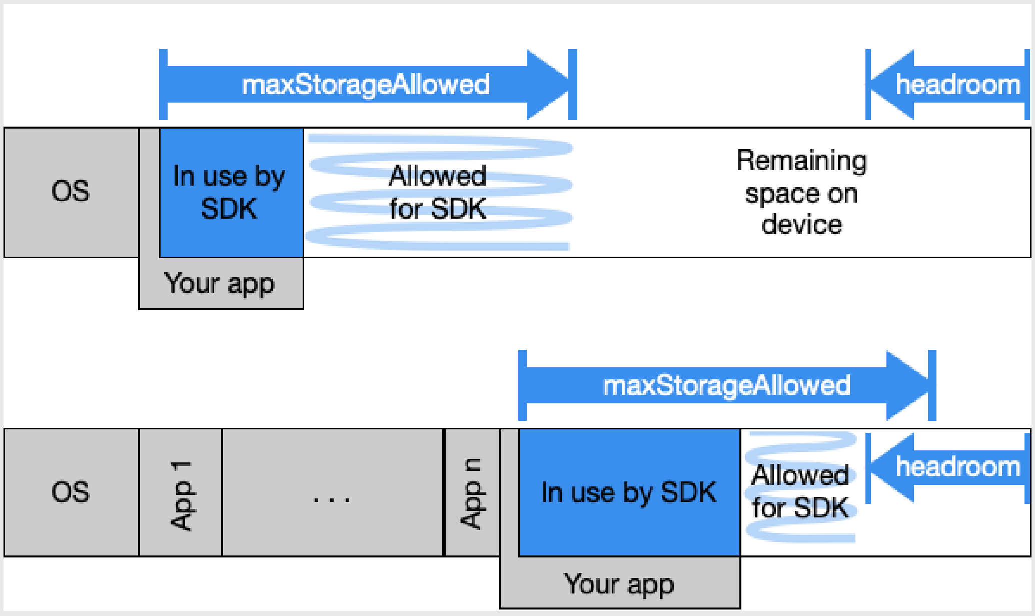
maxDownloadedAssetsOnDevice: Maximum number of assets that may be downloaded on this device at any given time. Any assets added to the queue beyond this limit will be blocked until existing assets are deleted. (default=100)

maxStorageAllowed: Maximum disk space that the SDK will use on the device. While downloading in the foreground, the SDK will cease download if it reaches maxStorageAllowed, even if that means stopping with a partially-completed file. While downloading in the background, the SDK will not initiate a download unless, after downloading that item, the total device storage used by the SDK will still be under maxStorageAllowed. (in MB; default=LONG_LONG_MAX)

headroom: Storage capacity that the SDK will leave available on the device. While downloading with the app in the foreground, the SDK will cease download if the headroom space is all that remains on the device, even if that means stopping with a partially downloaded item. When downloading in the background, the SDK will not initiate a download unless, after downloading that item, at least headroom space will still be free on the device. (in MB; default:1024)

NOTE

This diagram illustrates the relationship between `maxStorageAllowed` and `headroom` parameters. The SDK will always preserve a minimum free space on disk (“headroom”). In the first scenario the device has ample total available storage, so the SDK storage would be capped only by its `maxStorageAllowed`. In the second scenario, the device is beginning to fill up with other apps and is running low on available storage, so the SDK `headroom`requirement is restricting storage usage by the SDK. In the second scenario the SDK is no longer allowed to reach its `maxStorageAllowed` due to a lack of total available storage on the device.



NOTE

Once you have received a blocked state from the observer, you can call `[engine diskStatusOK]` which returns a boolean, indicating whether the SDK is blocked on disk/storage restrictions or something else.

Alternatively, you could also check `[VirtuosoAsset allowableStorageRemaining]`, which in that state will return 0.

Note that having insufficient space on the device is not considered to be a permanent fatal error, and so the SDK will continue its attempt to complete downloads once space has become available. For a headroom issue, downloads may continue after the deletion of anything on the device which provides more headroom. For a max storage issue, downloads may continue after removal of previously-downloaded items.

NOTE

Without knowing the file sizes ahead of time, or hosting content with a constant bitrate it can be extremely difficult to estimate file sizes. The estimated file size for videos is based on the selected bitrate to download and the duration of the asset. The SDK uses that information to calculate the initial expected size. Once download starts, we take the existing downloaded segments and create an "average segment size" for each segment type (audio, video, etc.) and then calculate an estimate based on the total number of segments multiplied by the average downloaded segment size. Naturally, with this approach, the estimated size will become more accurate over time.

downloadOverCellular: (default=NO) Whether the SDK is permitted to download over a cellular network. This value is a permission, and does not guarantee that downloads will continue on acellular network. It only indicates the the SDK may download over cellular, should internal business rules allow it. If this value is NO, downloads will never happen over a cellular connection.

destinationPath: An additional relative path component added to the enclosing app's Documents directory. The SDK will store all downloaded files here. By default, the SDK stores all downloads in the Documents directory itself, under appropriate sub-directories.

TIP

The iOS SDK, with `permittedSegmentDownloadErrors` on `VirtuosoSettings`, allows to configure the SDK to tolerate a non-zero number of segment failures before marking the asset as failed. See `VirtuosoSettings.h` for this and other related settings.

TIP

The Penthera iOS SDK has a read-only class-level property on VirtuosoAsset to read the downloadRetryLimit, which is set to 2.

Download Ancillary Files: iOS

The Penthera SDK provides the ability to download arbitrary additional files, which are managed by the SDK within the same lifecycle of the related asset. When the asset is later removed from the user device, the SDK will also automatically clean up the related ancillary files.

You may indicate ancillary files when you are configuring to construct your asset:

```
VirtuosoAncillaryFile *poster = [[VirtuosoAncillaryFile alloc]
initWithDownloadURL:posterURLString andTag:@"poster"];

VirtuosoAncillaryFile *thumbnail = [[VirtuosoAncillaryFile alloc]
initWithDownloadURL:thumbnailURLString andTag:@"thumbnail"];

VirtuosoAssetConfig *myConfig = [[VirtuosoAssetConfig alloc]
initWithURL:myAssetURLString assetID:myAssetID description:myDescription
type:kVDE_AssetTypeHLS];

[myConfig setAncillaries:@[poster, thumbnail]];

VirtuosoAsset *myAsset = [VirtuosoAsset assetWithAssetConfig:myConfig];
//now when the asset is processed on the download queue, the ancillaries
will also be retrieved
```

Once the SDK has completed download of the asset, the ancillary files can be accessed from the asset instance. You could access the ancillaries all at once with `findAllAncillaries`, but notice in the example that tags were used when declaring the ancillary files. These tags can be used to easily retrieve a specific ancillary file, such as poster images, ancillaries in other languages, or for any other purpose.

```
NSArray<VirtuosoAncillaryFile*>* myPosters = [myAsset
findCompletedAncillariesWithTag:@"poster"];
```

Enable/Disable Other Devices: iOS

In addition to startup and shutdown of the Virtuoso engine on a given device, you also have the option of enabling and disabling the download capability on a device. For example, if you use the Penthera Cloud setting to limit the number of download-enabled devices a user is allowed on their account, you may also want to provide the ability for your users to choose which of their devices is enabled for download at any given time. To support this, the SDK can change the enable/disable setting for the local device, or for any other device associated with the user's account. The Penthera Cloud manages which devices are download-enabled, and enforces the global "max download-enabled devices per user" policy.

The example below shows how to retrieve the listing of User devices and change the download setting on one of them. Notice that because the Penthera Cloud is involved in enforcing your business rules, this code for enabling and disabling devices behaves differently if the local device is offline or not authenticated when the request is made.

```
NSString *anExternalIdToMatch = @“AN_EXTERNAL_ID”; //device we wish to
change

NSArray *userDevices = [[VirtuosoDownloadEngine instance] devices];

  ... // find the device with matching external ID

[matchingDevice updateDownloadEnabled:FALSE onComplete:^(Boolean success,
NSError *error){
  //handle success or failure
}];
```

TIP

If a request to enable or disable a remote device is made while the remote device is offline, the state change is still recorded in the Penthera Cloud and will propagate to the remote device when it syncs with the Penthera Cloud. In general the impact on a remote device may experience various delays if the remote device is offline, if syncing is delayed for any reason, or if push notifications are delayed. As long as the device is eventually brought online and the SDK is running, it will eventually receive the state change.

DEVICE STARTUP & SYNCING MAY IMPACT BILLING

Startup of the Virtuoso engine from a client device, and the periodic sync the engine performs with the Penthera Cloud servers, are what identify a device as being "active" in the Penthera ecosystem. The number of active devices in a given month impacts Penthera resource utilization, and is the typical mechanism from which Penthera derives its client billing.

The typical best practice for a client application is to leave users in the active state who rely on download and other SDK features. For such users you would startup the Virtuoso engine soon after they launch or log in to your app, and you would leave the engine running so it can manage background downloads and other features automatically.

If you limit download and other SDK features to a subset of your users, such as a premium user account, you will normally only startup the Virtuoso engine for those premium users (and not for users who are unable to use Virtuoso SDK features).

Push Notifications: iOS

While not required, we do recommend integration of push notification messaging as it can produce the most timely execution of some Penthera features. Note that push notifications are not used by Penthera to pop up user messages in your mobile app UI; the SDK uses push notifications to receive internal messages from the Penthera Cloud.

For iOS devices, the Penthera Cloud can use Apple Push Notifications (APN) to send messages to the SDK which trigger certain actions (e.g., download and delete). What follows explains the basic steps for enabling APN with the Penthera SDK. For broader coverage of how APN works, see Apple's developer documentation.

Provide APN config to the Penthera Cloud

Log in to the Penthera Cloud admin console and provide your APNS configuration information.

Register device push tokens with SDK

To send a push message to a specific device, the Penthera Cloud (or "backplane") needs to know the push token from your app running on that device. The Penthera SDK will inject code into your AppDelegate chain to feed push tokens to the SDK, so the SDK can upload them to the Penthera Cloud. You do not need to write additional code for that process.

Handling Received Push Notices

From time to time, a server (the Penthera Cloud or possibly another server associated with your app) may send your app an APN message. Upon arrival the APN message is delivered to well-known methods in your UIApplicationDelegate class, otherwise known as the AppDelegate, as according to Apple documentation. A typical implementation of those AppDelegate methods will dispatch the message to whatever app code should handle it. The Penthera SDK will automatically inject (aka, "swizzle") the necessary code into your AppDelegate chain so that you do not need to write any custom code to route Penthera APN messages to the Penthera SDK. If your ecosystem is sending additional APN messages to your app which are not sent by the Penthera Cloud, these will not be handled by the Penthera SDK, and will continue to route to the methods in your AppDelegate implementation so your code can handle them as expected.

IMPORTANT

If you use push notifications within your app for other purposes, to ensure your push notifications work well together with the push notification handling performed automatically by the Penthera SDK, make sure you implement your push notification handling with Apple's recommended `didReceiveRemoteNotification:fetchCompletionHandler:` approach.

IMPORTANT

The automatic injection of APN handling code by the Penthera SDK is new as of SDK 4.0. If you are upgrading from versions of the Penthera SDK prior to 4.0, and you were already handling Penthera APN messages, see Upgrading the SDK: iOS [11] for info about what you should remove from your existing code during your upgrade.

PERFORMANCE WITH PUSH NOTIFICATIONS

For performance reasons, Penthera batches up "push notice jobs" into groups, and the job processor fires them at intervals. The default interval is every 5 minutes. When the push notices go out from the server, the platform push service accepts them and then they may be delivered, or not.

For instance, some push messaging providers reserve the right to delay push notices until "convenient" times for the device, which could be a device unlock or when the device starts up its wifi / cellular radio. So there can be a delay between the push being sent to the push notification provider and the actual push notice getting to the device. In addition, on some systems pushes are delivered quickly when the user is frequently using your app, but are delivered "less quickly" (the timing of which is imprecise) when a user less frequently uses your app.

Push notice delivery is also not guaranteed. Because push messaging is not a guaranteed service, the commands that Penthera sends in the push notice are also sent down to the device during application syncs.

If the device misses a push for some reason, the next time the SDK syncs with the backplane server, it will pickup whatever commands it missed and process them at that time.

The Penthera iOS SDK limits sync frequency to no more than one sync every 15 minutes. If a sync has not already happened within that time window, a sync will be attempted if the app starts, if the app connects to a network, if the SDK receives a push notification, or if a background wake occurs during background downloading.

Apple's push notification system is one which may delay push notifications. We recommend implementing the "background fetch" feature on iOS to allow for syncs to happen occasionally when the app is backgrounded, although the timing of those is not guaranteed by Apple.

Availability Windows for Assets: iOS

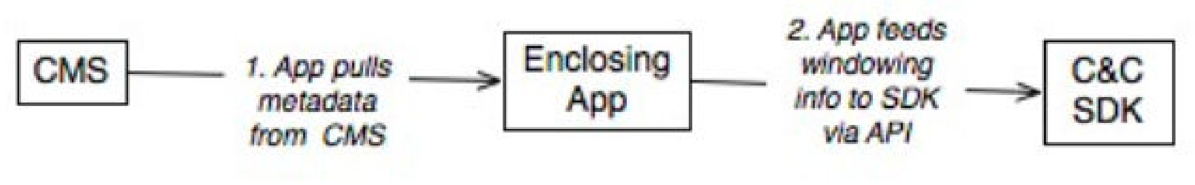
The 'Availability Window' governs when the video is actually available for playout by the user. The SDK enforces several windowing parameters on each video:

Table 1. Parameters for Availability Windows

Windowing Parameter	Description
Publish Date	The SDK will download the video as soon as possible, but will not make the video available through any of its APIs until after this date.
Expiry Date	The SDK will automatically delete the video as soon as possible after this date.
Expiry After Download (EAD)	The duration a video is accessible after download has completed. As soon as possible after this time period has elapsed, the SDK will automatically delete this video.
Expiry After Play (EAP)	The duration a video is accessible after first play. As soon as possible after this time period has elapsed, the SDK will delete this video. To enforce this rule, the SDK has to know when the video is played, so be sure to register a play-start event when the video is played.

The Penthera Cloud stores a global default value for EAP and EAD. You may set these values through the Penthera Cloud web UI. The Cloud transmits these default values to all SDK instances. Defaults provided by the Penthera Cloud can be overridden by values provided to the SDK by your app.

Typically, a Content Management System (CMS) stores the windowing information for an item, and communicates it through a web API to the enclosing app. The app then feeds this windowing information to the SDK:


CMS
1. App pulls metadata from CMS
Enclosing App
2. App feeds windowing info to SDK via API
C&C SDK

Overriding defaults with asset-specific values is performed when you create the VirtuosoAsset object. You can also modify some of the values later, via the appropriate properties.

```
VirtuosoAssetConfig *config = [[VirtuosoAssetConfig alloc]
    initWithURL:@"http://path/to/your/asset.mp4"
    assetID:@"your_unique_asset_id"
    description:@"Test Video"
    type:kVDE_AssetTypeNonSegmented];

// Available now
config.publishDate = [NSDate date];

// Expires in 7d
config.expiryDate = [NSDate dateWithTimeIntervalSinceNow:604800];

// Expires 24h after download
config.expiryAfterDownload = 86400;

// Expires 12h after play
config.expiryAfterPlay = 43200;

[VirtuosoAsset assetWithConfig:config];
```

Each of the SDK's content lookup methods (e.g. `assetsWithAvailabilityFilter:`) contains an `availabilityFilter` parameter. Set this parameter to YES to filter for only items still valid given windowing constraints. Set the parameter to NO to list all items, regardless of windowing.

The SDK will delete a video as soon as possible after the video expires. Also, when a caller tries to access an expired item via the API, any downloaded files associated with that item will be auto-deleted from disk, calls to play the item via the VirtuosoClientHTTPServer will fail, and any attempts to access the local file URLs will return nil.

NOTE

The expiry date can be changed remotely after an asset has been downloaded to disk, but the `expiryAfterDownload` and `expiryAfterPlay` values cannot.

NOTE
The Penthera SDK has an internal secure clock implementation that is entirely independent of the local clock time. The secure clock time is based on a combination of NTP calls and Penthera Backplane time stamping for "ground truth time" combined with tracked differentials of the system "up-time clock". All expiry calculations are done against this internal secure clock, and expiry is independent of the local clock settings. On both iOS and Android, you can check what the SDK secure clock is set to by using the public interfaces.

Advanced Topics

Upgrading the SDK: iOS

Unless the release notes indicate otherwise, SDK versions are back-compatible with older versions. If you had previously deployed a version of your app using an earlier version of the SDK, then the old data store will automatically be upgraded to the new data store. There are a few important considerations for handling of this process:

Asynchronous Update

Depending on how many assets the user has created in the app, the upgrade process may take a fair amount of time. To ensure that you can startup the engine without worrying about thread considerations, the SDK upgrades the data store in a background process. This allows your app to appear fully functional to the user, but it does mean that while the upgrade process is proceeding, previously-downloaded assets may be unavailable.

The VirtuosoDownloadEngine will issue two notifications via NSNotificationCenter to indicate when the upgrade process is starting and when the upgrade process has finished:

```
extern NSString* kDownloadEngineDidBeginDataStoreUpgradeNotification;
extern NSString* kDownloadEngineDidFinishDataStoreUpgradeNotification;
```

You can use these notifications as a trigger in your user interface to indicate to the user that previously downloaded assets are temporarily unavailable.

Download Continuity

All asset metadata will be fully available as soon as the data upgrade process completes. Any assets that had already been downloaded will be immediately available for offline playback. Any assets that had not started downloading yet will remain enqueued and will download normally.

Observing Manifest Parsing: iOS

It is possible to be notified when manifest parsing completes for a newly instantiated `VirtuosoAsset`. When constructing the asset, use the `assetWithConfig:onReadyForDownload:onParsingComplete:` method of `VirtuosoAsset`. Pass the appropriate completion block into the `onParsingComplete` parameter.

Note that the engine is optimized such that for manifest-driven asset it may begin download before the manifest is completely parsed. Thus you may receive a callback to `onReadyForDownload` completion blocks before `onParsingComplete` completion blocks.

Digital Rights Management (DRM): iOS

The Penthera SDK provides out-of-box support for Apple FairPlay (iOS 10+) and Google Widevine (iOS 8+) DRM, together with a mechanism to easily provide custom support for specialized DRM server requirements as necessary. With a few easy steps, the SDK will not only manage retrieval of DRM for you, it will also manage the lifecycle of keys for various assets, including refreshing the keys at appropriate intervals to ensure the best likelihood that keys are valid for offline playback when your user desires it. At playback, the SDK runs a local proxy server which provides the DRM keys and the video assets, so that SDK-managed keys are provided to your player of choice whenever necessary.

If you are using Penthera's built-in FairPlay or Widevine support you may not need additional code to fetch or persist DRM licenses. Providing little more than the URL of your DRM server, the SDK can automatically request a cacheable license when the download starts and will attempt to renew it when the download finishes. The SDK will also automatically delete DRM licenses when the asset is deleted.

A DRM server may also require special formatting or tokens in the request and/or response, so the SDK allows your implementation to provide increasing levels of custom configuration to meet common needs. For the most extreme cases you can create a deeply custom implementation which performs all the server interaction within the DRM and asset management framework provided by the SDK.

While not preferred, it is even possible in extreme cases to handle DRM license retrieval in your own code, and provide the licenses to the SDK to manage alongside the assets. For many DRM systems other than FairPlay and Widevine, no custom integration is necessary.

CAUTION
If you must handle DRM license retrieval with entirely custom code, we recommend that you fetch the DRM license before you tell the Penthera SDK to queue an asset for download. That way, you can be sure the DRM license is on the device when the video download finishes. If you wait until the video download finishes before fetching the license, you may run into trouble. If the asset download finishes while the app is in the background, your app may not have an opportunity to download the license before the device goes offline and the app can't fetch the license.

Apple FairPlay DRM

The Penthera SDK can support FairPlay DRM with little more than the URL to retrieve the client FairPlay certificate, the URL of the FairPlay DRM server, and the URL of the manifest for FairPlay-protected assets. Once provided with that information, the Penthera SDK supports offline playback of FairPlay-protected videos, provided that your FairPlay license server is configured to grant the appropriate permissions in the license.

Configure FairPlay DRM

Configuration of FairPlay with the SDK requires only to configure the client certificate URL and DRM server URL.

Configure Client Certificate URL

Provide the URL where the SDK can download the client's FairPlay application certificate during application startup:

```
[VirtuosoLicenseManager
    downloadClientAppCertificateFromURL:<certificate_url>
    forDRM:kVLM_FairPlay];
```

Configure DRM Server URL

Provide the URL to your FairPlay License Server during application startup

```
[VirtuosoLicenseManager
    setLicenseServerURL:<license_server_url>
    forDRM:kVLM_FairPlay];
```

Utilize FairPlay Assets

To utilize FairPlay assets, you need to identify them as such when asking the SDK to download them, and then play them back from the URL provided by the SDK.

Identify FairPlay Assets

When you start a new download by constructing a `VirtuosoAsset`, pass `kVDE_AssetProtectionTypeFairPlay` as the `protectionType` parameter to identify that asset as using FairPlay DRM. In addition to fetching the video assets, the SDK will send the raw encrypted SPC request and parse the raw encrypted response. The queue for download procedure is discussed further in Queue an Asset for Download: iOS.

Since it is typical for FairPlay metadata to be encrypted within the keys (and thus unreadable by the SDK), you may supply our SDK with the key renewal date using the `VirtuosoLicenseManagerDelegate` defined in `VirtuosoLicenseManager.h`. Otherwise, if the device is online at the time of playback, Apple will identify if a FairPlay license has expired and will make a renewal license call when the user attempts to play it. See DRM Extensions: iOS [15] for more details on the VirtuosoLicenseManagerDelegate.

Playback FairPlay Assets

If you are using one of player classes provided by the Penthera SDK, there is nothing special necessary for playback. Play assets just as indicated in Play Downloaded Content: iOS. The SDK will provide the DRM key to the player.

Playback of FairPlay Assets in a Custom Player

If you require a custom player for your application you may use methods directly on the `VirtuosoClientHTTPServer` class to perform the steps that the player classes we provide in the SDK would normally perform for you. These include instantiating a local playback proxy (the `VirtuosoClientHTTPServer` instance) for a given asset, obtaining the local proxy URL the player will use for playing the local asset, obtaining the local proxy URLs the player will use to obtain the DRM certificate and DRM key, and finally calling shutdown on the local proxy when your custom player is done. Below is specific guidance on how to playback FairPlay assets with a custom player.

1. Instantiate and hold a reference to an instance of our `VirtuosoClientHTTPServer`. The appropriate location for this is likely within a ViewController where you embed a player or from which you will open a child view controller containing the player. Hold a reference to our server instance until the user is done with playback.

    ```
    //Have access to the VirtuosoAsset you wish to play
    VirtuosoAsset *myAsset = ...

    //Instantiate a local proxy server instance with your desired asset
    VirtuosoClientHTTPServer *server = [[VirtuosoClientHTTPServer alloc]
    initWithAsset:myAsset];
    ```

2. Retrieve the playback URL and DRM URLs from the local proxy server instance you just created. Use these to configure your custom player for playback, which enables the player to have access to both the asset and DRM files being managed by the Penthera SDK.

```
if (server) {
  //The now-running server instance provides local proxy URLs for
playback and DRM

  NSString *licenseURL = [server fairPlayLicenseServerURL];
  NSString *certificateURL = [server
fairPlayCertificateDataURLForSubType:nil];
  //use these license and certificate URLs to configure DRM support in
your custom player

  NSString *playbackURL = [server playbackURL];
  //pass this playbackURL to your player

  //playback now happens in your player

} else {
  //returned nil because of some error… error would have been sent to
NSNotificationCenter
}
```

3. Later, after playback ends (e.g., player view closed), you want to shut down the instance of `VirtuosoClientHTTPServer`. At this point you can release the server reference. You must hold a reference to our server instance throughout playback, or our local proxy server will shut down prematurely.

```
[server shutdown];
```

Extended FairPlay Server Requirements

Frequently, DRM servers use specially-formatted requests and responses, such as specialized JSON-structured payloads, base-64 encoded elements, and custom parameters in the request string or headers. For those cases, read our section on DRM Extensions: iOS [15]

Google Widevine DRM: iOS

The Penthera SDK automatically supports offline playback of Widevine-protected videos, provided that your Widevine license server grants appropriate permissions for the license. Enabling Widevine support requires only the following:

1. Include the Google Widevine framework in your project. Location `widevine_cdm_sdk_release.framework` in the ThirdParty directory of your Penthera SDK distribution. Drag and drop the framework into your XCode project. Under the General section in “Embedded Binaries”, add the `widevine_cdm_sdk_release.framework` to the list.
2. Configure your Widevine License Server during application startup:

```
[VirtuosoLicenseManager
    setLicenseServerURL:<license_server_url>
    forDRM:kVLM_Widevine];
```

3. When you start a new download, pass `kVDE_AssetProtectionTypeWidevine` as the `protectionType` parameter.

If you are using one of Penthera SDK built-in player classes, that’s all you need to do.

Extended Widevine Server Requirements

Frequently, DRM servers use specially-formatted requests and responses, such as specialized JSON-structured payloads, base-64 encoded elements, and custom parameters in the request string or headers. For those cases, read our section on DRM Extensions: iOS [15]

DRM Extensions: iOS

You have likely seen that the `VirtuosoLicenseManager` is involved in DRM configuration, where in the simplest cases you provide the URLs for your DRM client certificate and your license server. This class is also your starting point for further extending and customizing DRM support within the Penthera SDK.

If your customization needs extend beyond what is capable with the VirtuosoLicenseManager, you may need to extend the SDK license functions using a `VirtuosoLicenseManagerDelegate`, or much less likely using the `VirtuosoAVAssetResourceLoaderDelegate`. Let us explore when you might need each of these mechanisms.

Enhancing DRM with the VirtuosoLicenseManager

First of all, note that various additional DRM features are possible using other methods on the `VirtuosoLicenseManager` API. With that API you can do things like:

- configure the SDK to simultaneously support various different DRM types, by providing different cert and server URLs for various DRM types and subtypes,
- provide a client DRM cert manually, rather than having the SDK fetch it from a remote URL, in the event you need to access or store your client cert in a custom manner,
- manually induce the download of an offline license key for an asset,
- manually induce the refresh of a license key,
- manually delete a license key from SDK management,
- provide a license key to the SDK for management which you acquired in a custom manner, and
- retrieve the managed license key for an asset, in case you need to manually provide it to a player in some custom manner rather than letting the SDK provide it during playback.

All of those functions can be found in methods of the `VirtuosoLicenseManager` class as detailed in the `VirtuosoLicenseManager.h` header.

Extending DRM with a VirtuosoLicenseManagerDelegate

The `VirtuosoLicenseManagerDelegate` is the most commonly used DRM extension point. This delegate allows you to set a specific renewal date on an asset's license key, append a custom suffix to the URL used to retrieve a license key, or add custom query parameters and request headers to the license key request. In each case you have access to the asset, so your customizations can either be generic to all requests (such as with a custom authentication token) or specific to the asset (such as providing an asset ID).

The simplest way to achieve this is by implementing the `lookupLicenseForAsset:` method, which returns a `VirtuosoLicenseConfiguration` instance containing your customizations. Implement the delegate method, provide any necessary customizations, leave unused customizations nil, and register your delegate with the `VirtuosoLicenseManager`:

```
[VirtuosoLicenseManager setDelegate:self];

...

#pragma mark - VirtuosoLicenseManagerDelegate

-(VirtuosoLicenseConfiguration* _Nullable)lookupLicenseForAsset:
(VirtuosoAsset* _Nonnull)asset
{
    VirtuosoLicenseConfiguration *config =
        [[VirtuosoLicenseConfiguration alloc]
            initWithSuffix:nil
            renewal:nil
            parameters:@{@"paramToken": @"xyzzy12345"}
            headers:@{
                @"Content-Type": @"application/json; charset=UTF-8",
                @"headerToken": @"token54321"
            }
        ];
    return config;
}
```

You may alternatively implement the older form method on the same delegate, which is called during license requests, and which provides values by implementing dereferenced parameters (leaving nil any which are not needed):

```
[VirtuosoLicenseManager setDelegate:self];

...

#pragma mark - VirtuosoLicenseManagerDelegate

- (void)lookupLicenseURLSuffix:(NSString * _Nonnull __autoreleasing *
_Nullable)urlSuffix
    andParameters:(NSDictionary * _Nonnull __autoreleasing *
_Nullable)customParameters
    additionalHeaders:(NSDictionary * _Nonnull __autoreleasing *
_Nullable)customHeaders
    renewalDate:(NSDate * _Nonnull __autoreleasing * _Nullable)renewalDate
    forAsset:(VirtuosoAsset * _Nonnull)asset
{
    // To customize elements of the DRM request, implement this method and
provide
    // any required modifications to the licensing properties according to
the provided asset.
    // For example:
    //    *urlSuffix = @"asset-unique-suffix-for-drm";
    //     Gets appended onto the end of the DRM license URL
    //    *customParameters = @{@"key":@"value"};
    //     key/value pairs that get added to the URL query string
    //    *customHeaders = @{@"key":@"value"};
    //     key/value pairs which become request headers
    //    *renewalDate = [NSDate dateWithTimeIntervalSinceNow:48_HOURS];
    //     Expected DRM renewal timestamp

    *customParameters = @{
        @"form": @"json",
        @"schema": @"1.0",
        @"account": @"http://someserver.com/data/Account/8675309",
        @"token": @"xyzzy12345"
    };
    *customHeaders = @{
        @"Content-Type": @"application/json; charset=UTF-8",
        @"myToken": @"token54321"
    };
}
```

Extending DRM with a VirtuosoAVAssetResourceLoaderDelegate

Sometimes your DRM license server may require special formatting of the request body, or extraction of the key from within a custom response body. For example, the default request body contents of a FairPlay server request are the raw bits of the SPC block, and the default response body contents are the raw bits of the CKC. If your FairPlay server requires to submit the SPC as part of a custom JSON request body, and/or returns the CKC embedded somewhere in a JSON response body, and/or requires base64 encoding of the request or response, you may use a `VirtuosoLicenseProcessingDelegate` to achieve these customizations.

The Penthera SDK provides and uses a default `AVAssetResourceLoaderDelegate`, in the form of our `VirtuosoDefaultAVAssetResourceLoaderDelegate`. If you need to implement our `VirtuosoLicenseProcessingDelegate` methods, you then register your `VirtuosoLicenseProcessingDelegate` delegate with our `VirtuosoDefaultAVAssetResourceLoaderDelegate` implementation, and the rest is handled for you.

To access or modify the request and/or response bodies, implement the request and response customization methods of the `VirtuosoLicenseProcessingDelegate`, and register your delegate instance with the `VirtuosoDefaultAVAssetResourceLoaderDelegate`:

```
[VirtuosoDefaultAVAssetResourceLoaderDelegate
setLicenseProcessingDelegate:self];

...

#pragma mark - VirtuosoLicenseProcessingDelegate

/* Deconstruct any custom DRM CKC response to extract and return the binary
license data. Returning nil causes the complete original binary CKC
response to be used as-is. */
- (NSData * _Nullable)extractCKCForAsset:(VirtuosoAsset * _Nonnull)asset
    inLicenseResponse:(NSData * _Nonnull)ckcData
{
    //handle the response body here, returning nil or the CKC bits
}

/* Construct any custom DRM SPC request from the asset and the default SPC
(which is a pure binary Fairplay SPC). The NSData returned from this method
is POSTed to the license server as the request body. Returning nil causes
the original binary SPC to be used as-is. */
- (NSData * _Nullable)prepareSPCForAsset:(VirtuosoAsset * _Nonnull)asset
    inLicenseRequest:(NSData * _Nonnull)spc
{
    //handle the request body here, returning nil or the customized request
body
}
```

The `VirtuosoLicenseProcessingDelegate` also provides a custom method for determining the CID. Normally, the asset CID is extracted from the FairPlay license URL, which takes the form: `skd://<contentID>`. Some license servers put the required content ID elsewhere, so if necessary, implement the following method and return a CID value other than nil:

```
[VirtuosoDefaultAVAssetResourceLoaderDelegate
setLicenseProcessingDelegate:self];

...

#pragma mark - VirtuosoLicenseProcessingDelegate

/* Extract and return the desired content ID from either the provided asset
or from the default Fairplay request URL. */
- (NSString * _Nullable)extractCIDForAsset:(VirtuosoAsset * _Nonnull)asset
    fromFairPlayRequest:(NSURL * _Nonnull)fpRequest
{
    //return nil if the URL contains the CID in standard sky://<contentID>
form, or
    //return another value, for example, if the asset ID is the content ID
    return asset.assetID;
}
```

If none of the above seems to resolve your custom DRM circumstances, contact Penthera Support. It is possible to leverage your own `AVAssetResourceLoaderDelegate` to serve as a child delegate to, or even as a replacement for, our default implementation `VirtuosoDefaultAVAssetResourceLoa-`

derDelegate. This is a more complex process, which is rarely required, but if it seems necessary please contact us first. We can help confirm it is actually necessary, and can assist you with the implementation.

Using BuyDRM or CastLabs DRM

As part of the SDK we also ship with support for two highly customized DRM adapters, one each for use with BuyDRM and CastLabs DRM servers. If you are using either of those DRM systems, you will replace our default `VirtuosoDefaultAVAssetResourceLoaderDelegate` with either our BuyDRM or CastLabs `AVAssetResourceLoaderDelegate`, which also we ship in the SDK. These are injected into the SDK similar to how you would use an entirely custom `AVAssetResourceLoaderDelegate`. For example:

1) Configure your FairPlay cert and CastLabs URLs. This is usually done in your `appDidFinishLaunching` method.

```
[VirtuosoLicenseManager downloadClientAppCertificateFromURL:@“<certificate
URL>" forDRM:kVLM_FairPlay];

[VirtuosoLicenseManager setLicenseServerURL:@"https://myCastlabsServer.com/
license-server-fairplay/" forDRM:kVLM_FairPlay];
```

2) Enable our built-in CastLabs integration. This can also be done right after the above setup:

```
// CastLabs Configuration
[VirtuosoLicenseManager registerAVAssetResourceLoaderDelegate:
[CastLabsAVAssetResourceLoaderDelegate class]];
```

3) Implement the `drmConfigForAsset:` method of the `VirtuosoDrmConfigDelegate`, and register that implementation with the custom `AVAssetResourceLoaderDelegate`. In our example, the `VirtuosoDrmConfigDelegate` method is implemented in the app delegate, but you can put this method into any logical component in your architecture as you see fit:

```
[CastLabsAVAssetResourceLoaderDelegate setDrmConfigDelegate:self];

...

#pragma mark - VirtuosoDrmConfigDelegate

- (VirtuosoDrmConfig*)drmConfigForAsset:(VirtuosoAsset*)asset
{
   // CastLabs Configured
   CastLabsDrmConfig *config = [CastLabsDrmConfig new];
   config.clUserID = @“<user id>”;
   config.clSessionID = @“<session id>”;
   config.clCustomerName = @“<customer name>”;
   return config;
}
```

Extended Features

FastPlay: iOS

FastPlay is a feature which provides instantaneous playback of ***streaming*** videos. FastPlay eliminates the frustrating time your user would spend waiting for the player to buffer enough video to start play-back. This provides a vastly improved experience when browsing your video catalog, and should also be applied to popular and featured videos which you highlight in your app UI.

As soon as it seems your user might be interested in playing a given streaming video, such as when that video is featured in your UI or when the user opens the detail page of a video, you should construct a FastPlay-enabled asset. You do not need to add FastPlay-enabled assets to your download queue. The SDK will immediately download and parse that manifest, and download the opening few seconds of the video. If the user then chooses to hit "play," you initiate playback of the FastPlay-enabled asset just as you would for an asset that had been added to the download queue. *The opening seconds of the video play instantly*, because they have already been downloaded to the local device, and when those opening seconds are exhausted the player automatically and seamlessly transitions into the buffered online stream. This allows your player to buffer a substantial amount of the video, with little or no wait to start playback.

If you have implemented even the most basic download features of the Penthera SDK, you can Fast-Play-enable your application with very simple code. You construct the asset in the same manner as for an asset you wish to add to the download queue, except you set a flag to enable FastPlay, and do not add that asset to the download queue.

For example, simply enable FastPlay on your `VirtuosoAssetConfig`, which you use to create your `VirtuosoAsset`:

```
VirtuosoAssetConfig *newAssetConfigForFastPlay = [[VirtuosoAssetConfig
alloc] initWithURL:myAssetURLString assetID:myAssetID
description:myDescription type:kVDE_AssetTypeHLS];

//enable FastPlay
[newAssetConfigForFastPlay setFastPlayEnabled:YES];
//disable offline playback (optimizes readiness if not also needed for
offline playback)
[newAssetConfigForFastPlay setOfflinePlayEnabled:NO];
//set other config settings as necessary

VirtuosoAsset *myAsset = [[VirtuosoAsset alloc]
initWithConfig:newAssetConfigForFastPlay];
```

Hold the asset reference in your code, and the SDK will silently prepare it for FastPlay. When the user wants to start playback, check the asset to see if it is FastPlay-ready, and if so you initiate playback with the same code you would if the asset was from the download queue. See for Play Downloaded Con-tent: iOS additional details.

TIP

For the fastest readiness with FastPlay, also disable offline playback on the `VirtuosoAssetConfig` when you create the asset. If the asset does not need to be downloaded for offline playback, this allows the engine to skip some steps and also optimizes bandwidth usage.

If the user has requested playback so soon that FastPlay is not yet ready, you simply fall back to playing the video direct from the online manifest as you would have without FastPlay.

```
if ([myAsset fastPlayReady]) {
  //initiate playback as you would for a downloaded asset
} else {
  NSString *onlineManifestURL = [myAsset assetURL];
  myAsset = nil;
  //now initiate playback with the online manifest URL
}
```

That is all that is required. The `fastPlayReady` flag on the asset is sufficient to know whether FastPlay preparations are complete when your user presses a button to start playback.

Auto-download: iOS

The Auto-download feature allows you to define any set of content as a playlist, and as the user finishes with one item in the playlist, another item will automatically be downloaded for them. Using Auto-download is an easy way to keep desirable content available on your users' devices.

You might engage Auto-download when your user chooses to download any episodic content, or provide the option after they have watched an episode of a series. You may provide an opt-in or opt-out approach. However you integrate the feature with your user experience, it becomes easy for the user to start following a series of content.

For episodic seasons, workout videos, news segments, movie trilogies, and other serial content, the next item defaults to the subsequent episode. You can even append dynamically to a playlist as new episodes are released, so Auto-download works for active series as well as completed seasons & content. Regardless, it is easy to provide a simple toggle in your UI to enable and disable Auto-download.

While there are various configuration parameters to tweak Auto-download behaviors, our default settings cover most needs. The Auto-download feature does not require server-side integration with the Penthera Cloud. The required code is minimal and is only in the client app. If you have episodic content defined in your catalog you already have all the necessary metadata.

All your client app needs to do is:

- Register lists of Asset IDs with the `VirtuosoPlaylistManager` in our client SDK
- Implement the single-method `VirtuosoPlaylistManagerDelegate` to allow the SDK to resolve each asset ID into a `VirtuosoAssetConfig` when it is time to download the next asset in the playlist

Once a playlist is defined in the app, when an asset contained in the playlist is watched and then deleted, the next available asset *which is not already on the local device* is queued for download. When Auto-download is enabled, each watched & deleted asset in a playlist will queue another unless one of the following occurs:

- the user has reached the end of the playlist,

- the user cancels the next asset while it is downloading,
- the user deletes the asset without watching it,
- your app code calls our "delete-all" method (see note one below),
- the asset expires without being played (see note two below), or
- the user manually disables the Auto-download feature in your UI (if you give that option)

This leads to an intuitive experience for the user. In fact, if the user manually downloads more than one asset from the same active playlist, the SDK will seek to keep that many episodes of the playlist available locally.

If the user has watched the last item in a playlist, when you add a new item to that playlist the new episode will immediately queue for download, so the user can follow an active series with no further effort!

NOTE
Note one: In a future release the design will simplify such that even a delete-all can trigger Auto-download.

NOTE
Note two: Any expiry *without playing* the asset will never trigger an Auto-download. When a played asset reaches its expiry-after-*play* deadline, Auto-download can download an item from a playlist.

However, in this first release of the Auto-download feature if a played asset happens to reach its expiry-after-***download*** deadline before its expiry-after-play deadline, Auto-download does ***not*** engage. In a future release the design will simplify slightly such that *any* expiry of a played asset can trigger Auto-download.

Implement the VirtuosoPlaylistManagerDelegate

The `VirtuosoPlaylistManagerDelegate` requires one method which allows the SDK to translate the desired episode Asset ID into the `VirtuosoAssetConfig` which will be used to instantiate the VirtuosoAsset. You need only implement the delegate and register it with `VirtuosoPlaylistManager`, and your delegate code will be called whenever appropriate.

```
class MyPlaylistDelegate : NSObject, VirtuosoPlaylistManagerDelegate {

    /*
     * This method is called by PlaylistManager when it needs next item in
a playlist
     */

    @objc func asset(forAssetID assetID: String) ->
VirtuosoPlaylistDownloadAssetItem {

        var config: VirtuosoAssetConfig?

        var myAssetInfo: MyAssetInfo?

        guard let myAssetInfo =
MyCatalogAccessor.instance().retrieveInfo(asset: assetID) else {
            return
VirtuosoPlaylistDownloadAssetItem(option: .PlaylistDownloadOption_TryAgainLa
ter);
}

        config = VirtuosoAssetConfig(url: myAssetInfo.manifestUrl,
                                     assetID: assetID,
                                     description: myAssetInfo.desc,
                                     type: .vde_AssetTypeHLS)

        guard let assetConfig = config else {
            return
VirtuosoPlaylistDownloadAssetItem(option: .PlaylistDownloadOption_SkipToNext
);
        }
        return VirtuosoPlaylistDownloadAssetItem(asset: assetConfig);
    }

}
```

Your delegate implementation should be registered with the SDK, likely during app launch in your `AppDelegate`:

```
VirtuosoPlaylistManager.setDelegate(myPlaylistDelegate)
```

Register a Playlist

Now that you have a `VirtuosoPlaylistManagerDelegate`, you simply need to declare playlists when appropriate. To register a playlist with the SDK:

```
DispatchQueue.global(qos: .background).async {
  let cheersSeason3Config = VirtuosoPlaylistConfig(name:
"CHEERS_S3_PLAYLIST")
  let cheersSeason3 = VirtuosoPlaylist(config: cheersSeason3Config,
                                        assets: ["CHEERS-S3-E1", "CHEERS-S3-
E2", "CHEERS-S3-E3"])
  VirtuosoPlaylistManager.instance().create(cheersSeason3)
}
```

Once the playlist is registered, if the user downloads, watches and deletes episode one, the SDK will automatically download episode two, and so on.

NOTE

It is also possible to define a playlist at the same time you create a new asset. In that case you attach the `VirtuosoPlaylist` to the `VirtuosoAssetConfig` you are going to use to create the `VirtuosoAsset`, and when that `VirtuosoAsset` is created, it will also register the playlist with the `VirtuosoPlaylistManager` for you.

Grow a Playlist

To add an episode to an existing playlist:

```
DispatchQueue.global(qos: .background).async {
  guard let playlist =
PlaylistManager.instance().find("CHEERS_S3_PLAYLIST") else { return }

  playlist.append(["CHEERS-S3-E4"])
}
```

TIP

For active seasons of episodic content, use the append feature when a new episode is available. If the user is caught up on the existing episodes, the new episode will automatically download to their device!

Refresh Playlists in the Background

When you add a new episode to a playlist after your user has watched all its existing episodes, you likely do not want to wait until the next time your user launches the app to become aware of the new episode. You want your app to become aware of the new episode even in the background so that the next time your user launches the app, the new episode is already downloaded for them!

To achieve this you may implement the `refresh` method of our `VirtuosoRefreshManagerDelegate`, and register your implementation with our `VirtuosoRefreshManager`. Your `refresh` method will be called at the specified interval so you can make a background check of your catalog for any new episodes on your user's current playlists. If you detect any new episodes available on those playlists in your catalog, simply update the playlist definition in our SDK, and Auto-download handles the rest.

TIP

Example 14 in the SDK demonstrates a working implementation of the `refresh` method on the `VirtuosoRefreshManagerDelegate`

What Next?

The following publications may be of interest:

Penthera 101: Introduction to Penthera Development

Penthera 201: Developing with the iOS SDK

Penthera 202: Developing with the Android SDK

Penthera 203: Best Practices

[3]

Penthera 302: Android SDK Beyond the Basics

Penthera 310: DRM Deep Dive

Penthera 311: Server-to-Server with the Backplane API

Penthera 312: Known Issues