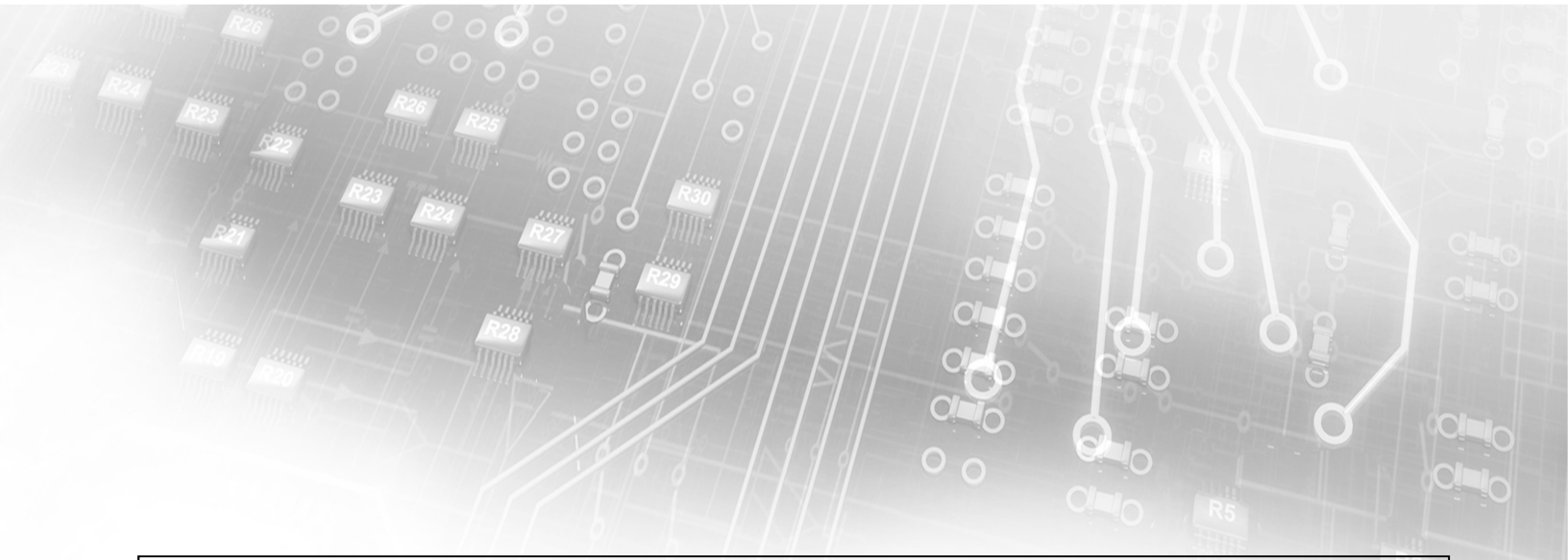

# DRM Integration Framework User Guide

Version 1.8

**Broadcom**
1320 Ridder Park Drive
San Jose, California 95131
**broadcom.com**

# Table of Contents

# 1 Revision History

| Issue | Date | By | Change |
|---|---|---|---|
| 1.0 | 10/15/2015 | Yuichi Aiba | Initial release |
| 1.1 | 10/29/2015 | Yuichi Aiba | Added a step to section 3.2 for correcting the system time on the board |
| 1.2 | 12/4/2015 | Yuichi Aiba | Added single process mode |
| 1.3 | 2/8/2016 | Yuichi Aiba | Updated command line options with Sage 2.8<br><br>Added mosaic mode with playback_dif |
| 1.4 | 7/13/2016 | Yuichi Aiba | Added PlayreadyPK 3.0 support |
| 1.5 | 7/28/2017 | Yuichi Aiba | Changed command line option for playback_dif app with Playready |
| 1.6 | 9/7/2017 | Yuichi Aiba | Added Widevine CENC v3.x support |
| 1.7 | 2/7/2018 | Yuichi Aiba | Small corrections in Runtime environment setup |
| 1.8 | 3/6/2018 | Yuichi Aiba | Modified to have Widevine CENC v3.x as default build for Sage mode |

# 2 Introduction

DRM Integration Framework (DIF) provides APIs that simplifies playback application development with DRM with SAGE/SVP support. Currently it supports Playready and Widevine.

We provide a sample application playback_dif which is a simple example to utilize the DIF APIs.

This document outlines how to build and run playback_dif example.

# 3 Building playback_dif example

## 3.1 Environment variable settings

1) Define URSR_TOP to point at the root folder of your URSR sources. This is optional and absolute path can be used to replace $(URSR_TOP). It is used in this document for convenience. For example:

```
export URSR_TOP=/projects/stbdev/$USER/repos/URSR_baseline
```

2) Set these platform specific environment variables:

```
export NEXUS_PLATFORM=<Platform_ID>

export BCHP_VER=<Revision>
```

Below is needed only if your board has a subtype like SV, VMS_SFF, C, DBS….etc.)

```
export NEXUS_USE_<ChipID>_<BoardSubType>=y
```

3) The following variables need to be set:

```
export NEXUS_MODE=proxy

export LINUX=<Kernel_path>

export PATH=<Toolchain_path>:$PATH

export MSDRM_PRDY_SUPPORT=y
```

Below is required if the chip is ARM processor.

```
export B_REFSW_ARCH=arm-linux
```

Currently multi-process mode is the default build. If you want to build single process mode, please set NXCLIENT_SUPPORT to “n”:

```
export NXCLIENT_SUPPORT=n
```

DIF will be built with SAGE/SVP support using the below setting. If you want to build without SAGE/SVP support, please set it to “n”:

```
export SAGE_SUPPORT=y
```

When SAGE_SUPPORT is set to y, Widevine CENC v3.x will be built with DIF by default. If you want to build CENC v2.x, please set WIDEVINE3x_SUPPORT to “n” Note that we can’t build both Widevine CENC v2.x and v3.x with DIF at the same time.

```
export WIDEVINE3x_SUPPORT=n #if you want CENC v2.x with SAGE
```

When SAGE_SUPPORT is set to n, CENC v2.x will be built always (Widevine CENC v3.x is not currently supported in non-sage mode).

## 3.2 Building DIF library and playback_dif example

You can build DIF library and playback_dif example at the same time using the following commands:

```
cd $URSR_TOP/BSEAV/lib/security/dif

make examples
```

An executable file “playback_dif” will be copied to $(URSR_TOP)/obj.$(NEXUS_PLATFORM)/nexus/bin together with libdif.so and other required libraries.

**Note**: Under some networks, you may get an error similar to the following (full path will be shown instead of $(URSR_TOP)):

```
================ Downloading OPENSSL tarball to
$(URSR_TOP)/obj.97439/BSEAV/lib/protobuf/arm-linux.debug
$(URSR_TOP)/BSEAV/lib/protobuf/protobuf-2.5.0
$(URSR_TOP)/obj.97439/BSEAV/lib/protobuf/arm-linux.debug
--2015-08-20 11:21:59-- https://protobuf.googlecode.com/files/protobuf-
2.5.0.tar.bz2
Resolving protobuf.googlecode.com... 74.125.20.82, 2607:f8b0:400e:c05::52
Connecting to protobuf.googlecode.com|74.125.20.82|:443... connected.
ERROR: cannot verify protobuf.googlecode.com's certificate, issued by
`/C=US/O=Google Inc/CN=Google Internet Authority G2':
Unable to locally verify the issuer's authority.
To connect to protobuf.googlecode.com insecurely, use `--no-check-
certificate'.
Unable to establish SSL connection.
Tarball $(URSR_TOP)/obj.97439/BSEAV/lib/protobuf/arm-linux.debug/protobuf-
2.5.0.tar.bz2 is missing
Makefile:98: recipe for target 'source' failed
make: *** [source] Error 1

make: Leaving directory '$(URSR_TOP)/BSEAV/lib/protobuf'================
```

As a workaround, you can use curl as follows and then proceed with the build command again.

```
curl https://protobuf.googlecode.com/files/protobuf-2.5.0.tar.bz2 >
$(URSR_ROP)/obj.97439/BSEAV/lib/protobuf/arm-linux.debug/protobuf-
2.5.0.tar.bz2
```

# 4 Runtime environment setup

## 4.1 Preparing drm.bin, playready.bin and playready3x.bin

Please prepare appropriate drm.bin and playready.bin for your board. If DIF was built with SAGE_SUPPORT=y, prepare playready3x.bin as well. Then copy them to the directory where playback_dif executable exists.

You need version 3.1.0 or higher of the DRM Utility to generate a proper “drm.bin” and “playready.bin” files. drm.bin needs to be generated with a “WIDEVINE_PLAYBACK” key and playready.bin needs to include PRDY_2.5 key while playready3x.bin needs PRDY_3.0. You can generate a single bin file with all keys and copy it to drm.bin and playready.bin (and playready3x.bin).

Note that these binary files generated with older versions of the DRM utility will not work properly. Also these bin files for SAGE/SVP support cannot be used for a build without SAGE/SVP support.

### Obtaining OTP ID for your board (optional)

If you need to obtain drm.bin for your board, please follow the instructions here, otherwise, jump to the next section. This section describes how to obtain OTP ID for your board which is needed for getting appropriate drm.bin. However, it is assumed that you have instructions on how to obtain the drm.bin.

OTP can be retrieved with 2 steps below

a. Build otpgetchipid – The commands below build Nexus along with the app otpgetchipid.

```
plat <Platform_ID> <Revision>

export SAGE_SUPPORT=n

cd nexus/examples/security/otp/nexus

make
```

b. Run otpgetchipid on your board.

Boot the board up to the shell prompt.

```
mount –t nfs NFS_SERVER_IP:/<path-to-built-nexus-and-otpgetchipid>
/mnt/nfs

./nexus otpgetchipid
```

Note the OTP id Displayed on the console.

drm.bin can then be requested as per the OTP ID and board type.

## 4.2 Mounting the build and setting up runtime environment

Copy the build (contents of $(URSR_TOP)/obj.$(NEXUS_PLATFORM)/nexus/bin) to your NFS server and mount it from your board using the following example. The example below assumes that it is mounted under /mnt/nfs on the device (Here '#' is a command prompt on the terminal of the board).

```
#mount –o nolock NFS_SERVER_IP:/<path-to-built-nexus-bin> /mnt/nfs
```

Make sure that the directory <path-to-built-nexus-bin> containing Nexus, required libs (such as libdif.so, libwvcdm.so, libplayreadypk_host.so, libcmndrm*.so, etc.) and playback_dif is mounted using nfs from the device. Also the permissions of these files must be properly set for the runtime user's access. The <path-to-built-nexus-bin> directory must be writable to the runtime user.

Make sure that drm.bin and playready.bin are present with at least read permission for the runtime user in the current directory.

```
#cd /mnt/nfs

# ls -l drm.bin playready.bin playready3x.bin

-r--r--r--    1 15176    841        24016 Jul 13 17:18 drm.bin

-r--r--r--    1 15176    841        24016 Jul 13 17:19 playready.bin

-r--r--r--    1 15176    841        24016 Jul 13 17:20 playready3x.bin
```

If not running playback_dif from `/mnt/nfs`, set up your PATH to include the directory where playback_dif exists.

```
# PATH=$PATH:/mnt/nfs

# which playback_dif

/mnt/nfs/playback_dif
```

Make sure the system time is correct. The below example shows a wrong system time.

```
# date

Thu Jan  1 00:04:34 UTC 1970
```

An easy way to set the correct time is to run ntpd command for example:

```
# ntpd -n -q -p us.pool.ntp.org
```

The above command is supposed to return when the system time is updated. However, it may fail sometimes. Run the commend again or set the current time manually.

For single process mode, run the following command to make video or audio only streams play in natural speed:

```
# export config="force_vsync=y"
```

For multi process mode, start nxserver. This step is not required for single process mode.

```
#cd /mnt/nfs

#./nexus nxserver -memconfig videoDecoder,svp,all,s -memconfig
display,svp,all,s &
```

If you are connecting to a TV with HDCP2.2, a file with HDCP2x keys need to be given to start nxserver. The below example shows how to specify drm.bin which includes HDCP2x keys:

```
#./nexus nxserver -memconfig videoDecoder,svp,all,s -memconfig
display,svp,all,s -hdcp2x_keys /mnt/nfs/drm.bin -hdcp m &
```

# 5 Running playback_dif example

Make sure that Environment is setup according to section 4 above.

## 5.1 Play CENC media

1. From host machine, visit http://dash-mse-test.appspot.com/media.html from browser.
2. Scroll down to “OOPS_CENC” secion and download a CENC media file such as oops_cenc-20121114-142.mp4 and copy it to the directory in your NFS server where playback_dif exists. Make sure the read permission is set for the runtime user.

   The first 6 files (numbering from 142 to 146) include only video data and the following 3 files (numbering from 148 to 150) include only audio data. oops_cenc-20121114-161.mp4 is video only.

   These CENC media can’t be played with Playready 3.x because the license server doesn’t support it.
3. Run playback_dif with Playready 2.5 DRM

   Multi-process mode:

   ```
   # ./nexus.client playback_dif -secure -pr:g oops_cenc-20121114-145.mp4
   ```

   Single process mode:

   ```
   # ./nexus playback_dif -secure -pr:g oops_cenc-20121114-145.mp4
   ```

   **NOTE 1: If you built DIF with SAGE_SUPPORT=n, please remove “-secure” option from the command line. The same condition is applied for all the examples in this document.**

**NOTE 2: "-pr:g" means that playback_dif uses GooglePlay license server to acquire a license. Without ":g", it will use default Playready license server which doesn't work for oops_cenc-20121114-xxx.mp4.**

4. Run playback_dif with Widevine CENC v2.x

   **This mode is available when you build DIF with "export WIDEVINE3x_SUPPORT=n" or "export SAGE_SUPPORT=n"**

   Multi-process mode:

   ```
   # ./nexus.client playback_dif -secure –wv oops_cenc-20121114-145.mp4
   ```

   Single process mode:

   ```
   # ./nexus playback_dif -secure –wv oops_cenc-20121114-145.mp4
   ```

5. Run playback_dif with Widevine CENC v3.x

   **This mode is available by default when you build DIF with "export SAGE_SUPPORT=y" and not available when you build DIF with "export SAGE_SUPPORT=n"**

   Multi-process mode:

   ```
   # ./nexus.client playback_dif -secure –wv3x oops_cenc-20121114-145.mp4
   ```

   Single process mode:

   ```
   # ./nexus playback_dif -secure –wv3x oops_cenc-20121114-145.mp4
   ```

6. Run playback_dif without DRM option. This will select a DRM that is found in the first PSSH box in the media file (below results in Widevine DRM).

   Multi-processmode:

   ```
   # ./nexus.client playback_dif -secure oops_cenc-20121114-145.mp4
   ```

   Single processmode:

   ```
   # ./nexus playback_dif -secure oops_cenc-20121114-145.mp4
   ```

## 5.2 Play PIFF media

1. From host machine, visit http://playready.directtaps.net/smoothstreaming.
2. Scroll down to "SSW 720p H264 PLAYREADY (SuperSpeedWay, 720p, H264 AAC, with encryption)" section and download an ISMV file such as SSWSS720H264PR/SuperSpeedway_720_2962.ismv and copy it to the directory in your NFS server where playback_dif exists. Make sure the read permission is set for the runtime user.

Those files include both audio and video data and playback_dif can play the video with audio.

3. Run playback_dif with Playready 2.5 DRM

   Multi-process mode:

   ```
   # ./nexus.client playback_dif -secure –pr SuperSpeedway_720_2962.ismv
   ```

   Single process mode:

   ```
   # ./nexus playback_dif -secure –pr SuperSpeedway_720_2962.ismv
   ```

4. Following command will result in Playready DRM (same as above)

   Multi-process mode:

   ```
   # ./nexus.client playback_dif -secure SuperSpeedway_720_2962.ismv
   ```

   Single process mode:

   ```
   # ./nexus playback_dif -secure SuperSpeedway_720_2962.ismv
   ```

5. Run playback_dif with Playready 3.x DRM

   Multi-process mode:

   ```
   # ./nexus.client playback_dif -secure –pr3x
   SuperSpeedway_720_2962.ismv
   ```

   Single process mode:

   ```
   # ./nexus playback_dif -secure –pr3x SuperSpeedway_720_2962.ismv
   ```

6. If you specify a DRM that is not supported in the media, playback_dif will ask if you want to continue with the default DRM (=Playready). You can enter ‘y’ or ‘n’.

   ```
   # ./nexus.client playback_dif -secure –wv SuperSpeedway_720_2962.ismv

   *** 00:00:00.015 playback_dif: PiffParser was initialized for
   SuperSpeedway_720_2962.ismv

   ### 00:00:00.015 playback_dif: DRM Type: 2 was not found in the stream.

   ### 00:00:00.015 playback_dif: Do you want to play it with its default DRM
   type: 3? [y/n]
   ```

## 5.3 Mosaic mode with CENC files

This feature is only supported in multi-process mode. Up to 8 videos can be played with playready 2.5 and widevine mixed.

1. From host machine, visit http://dash-mse-test.appspot.com/media.html from browser.
2. Scroll down to "OOPS_CENC" secion and download low resolution CENC media files such as oops_cenc-20121114-142.mp4 and oops_cenc-20121114-161.mp4, and copy them to the directory in your NFS server where playback_dif exists. Make sure the read permission is set for the runtime user.
3. Run playback_dif with several cenc files

   Below example plays 4 videos, two of which are played with Widevine and the others played with Playready 2.5:

   ```
   # ./nexus.client playback_dif -secure oops_cenc-20121114-142.mp4 –pr:g
   oops_cenc-20121114-142.mp4 oops_cenc-20121114-161.mp4 –pr:g oops_cenc-
   20121114-161.mp4
   ```

   Below example plays 5 videos where Playready 2.5 and Widevine are placed alternately:

   ```
   # ./nexus.client playback_dif –secure –pr:g oops_cenc-20121114-161.mp4
   oops_cenc-20121114-142.mp4 –n 5
   ```

   **NOTE : "-pr:g" means that playback_dif uses GooglePlay license server to acquire a license. Without ":g", it will use default Playready license server which doesn't work for oops_cenc-20121114-xxx.mp4.**

## 5.4 Mosaic mode with PIFF files

This feature is only supported in multi-process mode. Up to 8 videos can be played, but currently only one video can be played with Playready 3.x. Please combine multiple playready 2.5 and just one 3.x.

1. From host machine, visit http://playready.directtaps.net/smoothstreaming.
2. Scroll down to "SSW 720p H264 PLAYREADY (SuperSpeedWay, 720p, H264 AAC, with encryption)" section and download low resolution ISMV files such as SSWSS720H264PR/SuperSpeedway_720_230.ismv and SSWSS720H264PR/SuperSpeedway_720_331.ismv. Copy them to the directory in your NFS server where playback_dif exists. Make sure the read permission is set for the runtime user.
3. Run playback_dif with several PIFF files

   Below example plays 2 videos, one of which is played with Playready 3.x and the other played with Playready 2.5:

```
# ./nexus.client playback_dif -secure -pr3x SuperSpeedway_720_230.ismv
SuperSpeedway_720_331.ismv
```

Below example plays 4 videos. Only first one of is played with Playready 3.x and the others played with Playready 2.5:

```
# ./nexus.client playback_dif -secure -pr3x SuperSpeedway_720_230.ismv
SuperSpeedway_720_331.ismv SuperSpeedway_720_230.ismv
SuperSpeedway_720_331.ismv
```

## 5.5 Persistent License with Widevine CENC v3.x

Persistent license feature was introduced with Widevine CENC v3.2 (URSR 17.3 and later). The license is stored in local file system and used for future playback without communicating with the license server. As long as the license is valid, the playback will be done successfully. The playback_dif example provides sub-options for "-wv3x" to test this feature.

**This mode is available by default when you build DIF with "export SAGE_SUPPORT=y" and not available when you build DIF with "export SAGE_SUPPORT=n"**

1. Follow steps #1 and #2 in section 5.1 above to get sample CENC media

2. Run playback_dif with Widevine CENC v3.x in persistent license mode

   With "-wv3x:p" option, the license will be acquired from the license server and then stored in the local file system.

   Multi-process mode:

   ```
   # ./nexus.client playback_dif -secure –wv3x:p oops_cenc-20121114-
   145.mp4
   ```

   Single process mode:

   ```
   # ./nexus playback_dif -secure –wv3x:p oops_cenc-20121114-145.mp4
   ```

3. Check the stored license

   The license will be stored in a directory "widevine/L1" under the current directory. You will find files with ".lic" extension. The below example shows there are two stored licenses - ksidD4CA0BA6 and sid2. Please remember which license was created for each playback.

   ```
   # ls widevine/L1/

   cert.bin          ksidD4CA0BA6.lic  sid2.lic
   ```

4. Run playback_dif using the stored license

With “-wv3x:p:<license name>” option (license name is the file name without “.lic”), the stored license will be read from the file system and used for playback.

Multi-process mode:

```
# ./nexus.client playback_dif -secure –wv3x:p:sid2 oops_cenc-20121114-145.mp4
```

Single process mode:

```
# ./nexus playback_dif -secure –wv3x:p:sid2 oops_cenc-20121114-145.mp4
```

You will notice that there are no communications with the license server.