Advanced Micro Devices

Advanced Media Framework – Display Capture

Programming Guide

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1 Introduction

The AMD Advanced Media Framework (AMF) includes functionality for display capture to facilitate various streaming solutions in remote display, network game streaming and other applications. The display capture function is designed to work in conjunction with other AMF components, such as H.264, H.265 and AV1 encoders and color space converter.

AMF currently offers two components to perform display capture. One legacy component is using the Microsoft DXGI Desktop Duplication API (DD), while the new component utilizes an AMD's proprietary API to perform screen capture. The new display capture API is not available in legacy drivers, however it provides a more efficient way to perform display capture with lower latency and lower impact on the CPU and GPU performance. It is therefore recommended to use the new API for solutions where compatibility with legacy drivers is not required.

Functionally both methods are equivalent and implement the same API. The legacy DD component is available in the source code form as a sample.

Note: The Display Capture API requires root or super user privileges when running on Linux systems.

Note: For Linux, to disable Delta Color Compression (DCC), put `export AMD_DEBUG=nodcc` into `.profile` in the home directory and reboot. DCC is a domain-specific compression that tries to take advantage of data coherence. The key idea is to process whole blocks instead of individual pixels. DCC is image compression on the captured surface and such surfaces cannot be submitted to the encoder directly. Therefore, either DCC needs to be disabled or the surfaces need to be copied or submitted to the color converter before submitting to the encoder.

2 Display Capture Programming Model

AMF provides a standard component implementing the `AMFComponent` interface to perform display capture. For more information about the `AMFComponent` interface please refer to Section 2.6.1 of the AMF API Reference.

The Display Capture component is a source and does not take any input.

2.1 Creating the Display Capture Component

To create an instance of the Display Capture component, call the `AMFFactory::CreateComponent()` method passing `AMFDisplayCapture` as parameter. Include the `public/include/components/DisplayCapture.h` header.

The open source legacy Display Capture component based on the Microsoft DXGI Desktop Duplication API is included in the AMF samples in form of source code. It can be created by calling the `AMFCreateComponentDisplayCapture` function defined in `public/src/components/DisplayCapture/DisplayCaptureImpl.cpp`. Refer to the public DVR sample for details.

2.2 Initializing the Display Capture Component

The Display Capture component is initialized by calling the `AMFComponent::Init` method. Prior to calling `AMFComponent::Init` a number of properties must be set on the component object using the `AMFPropertyStorage::SetProperty` method:

Name	Type
AMF_DISPLAYCAPTURE_MONITOR_INDEX	amf_int64
AMF_DISPLAYCAPTURE_FRAMERATE	AMFRate

Table 1. Properties of the SetProperty method

Name: `AMF_DISPLAYCAPTURE_MONITOR_INDEX`

Values: `IDXGIFactory::EnumAdapters` for Windows, index on `libdrm` display enumeration on Linux

Default Value: `0`

Description: A monitor index to capture, determined by calling `IDXGIFactory::EnumAdapters`, 0 specifies the default monitor.

Name: `AMF_DISPLAYCAPTURE_FRAMERATE`

Values: Desired capture output framerate for `FRAMERATE` mode

Default Value: `(0,1)`

Description: Frame rate to perform the capture at. Setting the numerator to 0 causes the capture to be performed at the rate defined by either the application's flip frequency (for full-screen applications) or by DWM (for windows applications).

You can implement custom control of timestamps on each captured frame by providing a custom implementation of the `AMFCurrentTime` interface defined in `public/include/core/CurrentTime.h` and assigning it to the `AMF_DISPLAYCAPTURE_CURRENT_TIME_INTERFACE` property. By default, when the `AMF_DISPLAYCAPTURE_CURRENT_TIME_INTERFACE` property is not set, timestamps are assigned the value returned by `amf_high_precision_clock()` function at the time when a frame is captured.

Once the properties are set, call the `AMFComponent::Init` method. Pass `AMF_SURFACE_UNKNOWN` for `format` and zeros for `width` and `height`.

Once successfully initialized, the Display Capture component can be queried for output.

Upon initialization, the following properties can be read using the `AMFPropertyStorage::GetProperty` method:

Name	Type
AMF_DISPLAYCAPTURE_FORMAT	amf_int64
AMF_DISPLAYCAPTURE_RESOLUTION	AMFSize
AMF_DISPLAYCAPTURE_ROTATION	AMF_ROTATION_ENUM

Table 2. Properties of GetProperty method

Name: `AMF_DISPLAYCAPTURE_FORMAT`

Values: `AMF_SURFACE_FORMAT`

Default Value: `N/A`

Description: Capture format (`AMF_SURFACE_FORMAT`).

Name: `AMF_DISPLAYCAPTURE_RESOLUTION`

Values: A valid size.

Default Value: `N/A` or `(0,0)`

Description: Captured image resolution; An output parameter representing actual screen/display size.

Name: `AMF_DISPLAYCAPTURE_ROTATION`

Values: `AMF_ROTATION_ENUM` : `AMF_ROTATION_NONE` , `AMF_ROTATION_90` , `AMF_ROTATION_180` , `AMF_ROTATION_270`

Default Value: `AMF_ROTATION_NONE`

Description: Rotation of monitor being captured, `AMF_ROTATION_NONE` by default.

2.3 Querying for Output

The output of the Display Capture component can be obtained by calling the `AMFComponent::QueryOutput` method in a loop. The loop needs to run fast enough to sustain the frame rate set during initialization using the `AMF_DISPLAYCAPTURE_FRAMERATE` property. When a frame is available, `AMFComponent::QueryOutput` places a pointer to the `AMFSurface` object at the location pointed to by the `ppData` parameter. When no new frame is available yet, `ppData` is set to `NULL` and `AMFComponent::QueryOutput` returns `AMF_REPEAT` .

As with any other AMF component, it is recommended to run the polling loop in a separate thread. Whenever `AMFComponent::QueryOutput` returns `AMF_REPEAT` , the polling thread should be put to sleep for at least 1 ms to avoid high CPU utilization.

The `AMFSurface` object containing a captured frame that was obtained from `AMFComponent::QueryOutput` can be used as input for the next component in the pipeline.

The capture contained in the returned `AMFSurface` can also be modified with the following properties:

`AMF_DISPLAYCAPTURE_DUPLICATEOUTPUT` , of type `amf_bool` , false by default. If set, the frame returned in the `AMFSurface` object will be a copy the last captured output.

`AMF_DISPLAYCAPTURE_ENABLE_DIRTY_RECTS` , of type `amf_bool` , false by default. If set, dirty rectangles indicating changed areas in frame since last output are attached to the returned `AMFSurface` as the property `AMF_DISPLAYCAPTURE_DIRTY_RECTS` (See Section 2.5).

`AMF_DISPLAYCAPTURE_DRAW_DIRTY_RECTS` , of type `amf_bool` , false by default. If set, the captured output in the `AMFSurface` will have the dirty rectangles drawn in red. For debugging purposes only.

2.4 Shutting Down Display Capture

To stop display capture, call `AMFComponent::Drain` . You can exit the polling loop and terminate the polling thread once `AMFComponent::QueryOutput` returns `AMF_EOF` .

Call `AMFComponent::Terminate` and release the pointer to the Display Capture component.

2.5 Capture modes

Application can select three capture modes by setting `AMF_DISPLAYCAPTURE_MODE` into one of three modes:

Name	Type
AMF_DISPLAYCAPTURE_MODE_KEEP_FRAMERATE	AMF_DISPLAYCAPTURE_MODE_ENUM
AMF_DISPLAYCAPTURE_MODE_WAIT_FOR_PRESENT	AMF_DISPLAYCAPTURE_MODE_ENUM
AMF_DISPLAYCAPTURE_MODE_GET_CURRENT_SURFACE	AMF_DISPLAYCAPTURE_MODE_ENUM

Table 3. AMF Capture modes

Name: `AMF_DISPLAYCAPTURE_MODE_KEEP_FRAMERATE`

Value: `0`

Description: Component will keep requested framerate, repeating frame if new present didn't happen

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Name: `AMF_DISPLAYCAPTURE_MODE_WAIT_FOR_PRESENT`

Value: `1`

Description: Component returns captured frame with presentation rate: DWM or full screen app.

Name: `AMF_DISPLAYCAPTURE_MODE_GET_CURRENT_SURFACE`

Value: `2`

Description: Component returns current frame immediately.

If available, the output surface will have the following properties:

Name	Type
AMF_DISPLAYCAPTURE_FRAME_INDEX	amf_int64
AMF_DISPLAYCAPTURE_FRAME_FLIP_TIMESTAMP	amf_int64
AMF_DISPLAYCAPTURE_DIRTY_RECTS	AMFBufferPtr

Table 4. Output surface properties

Name: `AMF_DISPLAYCAPTURE_FRAME_INDEX`

Values: <= `0`

Default Value: `0`

Description: Index of present call for the current captured frame starting from beginning of capture.

Name: `AMF_DISPLAYCAPTURE_FRAME_FLIP_TIMESTAMP`

Values: <= `0`

Default Value: `0`

Description: Flip timestamp of the presented frame acquired by `QueryPerformanceCounter()`.

Name: `AMF_DISPLAYCAPTURE_DIRTY_RECTS`

Values: `AMFBufferPtr`

Default Value: `N/A`

Description: Array of `AMFRect` objects indicating changed areas on the captured surface since the last capture. The structure of `AMFRect` can be found in `public/include/core/Platform.h`.

Name: `AMF_DISPLAY_CAPTURE_DCC`

Values: `true` or `false`

Default Value: `N/A`

Description: Set to `true` when DCC compression is enabled on the output surface.
