

Advanced Micro Devices

Advanced Media Framework – Pre- Analysis Component

Programming Guide

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1 Introduction

1.1 Scope

This document describes the Pre-Analysis (PA) component of the AMD Advanced Media Framework (AMF). Full documentation on AMF can be found at <https://gpuopen.com/gaming-product/advanced-media-framework/>.

1.2 Overview

The AMF PA component accepts raw input images in NV12 format. It calculates a metric for content activity of different blocks across every image, as well as video property flags such as scene change and static scene flags. In the current release, spatial complexity is used as a measure of activity inside each block.

These results can be leveraged during an encode session targeting improved perceptual quality of the encoder's reconstructed video signal, or it can be used to report information back to any other application for leverage in a way the SDK user may see fit. The AMF PA component does not alter the input images in any way; pixels within images will be inspected but no pixel value will be changed.

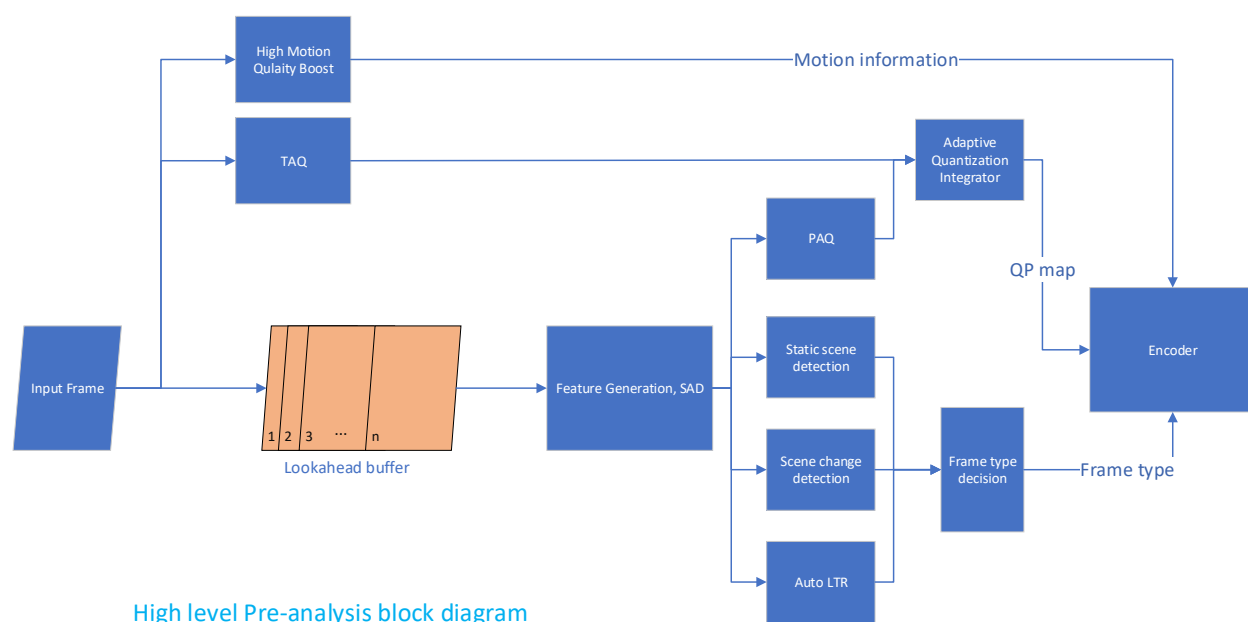


Figure 1 high level PA block diagram

The AMF PA component aims at being codec-agnostic. Content adaptive encoding using PA may also help to expand the HW encoder's capabilities. The analysis results will be used by AMD HW encoder(s) to potentially improve the overall encoding quality. Perceptual quality improvement impacts the distribution of bits among different video units, and hence it may sometimes lead to drops in quality when measured in objective metrics such as PSNR.

The AMF PA component can be used in one of two modes: encoder mode or standalone mode. In the encoder mode, the AMF PA component is instantiated as part of the AMF HW encoder pipeline. It analyzes the encoder input data before encoding. In the standalone mode, the AMF PA component is instantiated as a separate AMF component. It takes in raw video images and outputs a set of video statistics, which can be passed to third party encoder(s) or any other application(s).

1.3 Supported Hardware

The AMF PA feature is supported by Radeon RX 5000 Series or newer GPUs as well as Ryzen 2000 U/H series or newer APUs.

1.4 Disclaimer

The current AMF PA component is in its beta release. Existing features may get optimized over time, and new features may also be added in future releases.

2 AMF PA - Encoder Mode

The AMF PA component is instantiated within the AMF Encoder component as part of the encoder's pipeline. The encoder's input is first pre-analyzed by PA. During encoding, when either `AMF_PA_PAQ_MODE` or `AMF_PA_TAQ_MODE` is enabled, adaptive quantization is applied based on the results generated by PA. The encoder also makes various encoding decisions based on PA results. For example, depending on whether the PA scene change detection flag is triggered or not, the encoder may force an intra encoded frame and apply a new frame QP at the new scene. The encoder may also insert a skip frame based on whether the PA static scene detection flag is triggered or not.

`AMF_PA_PAQ_MODE` and `AMF_PA_TAQ_MODE` cannot work with VBAQ (`AMF_VIDEO_ENCODER_ENABLE_VBAQ`) features. When `AMF_PA_PAQ_MODE` or `AMF_PA_TAQ_MODE` is enabled, VBAQ settings are ignored.

`AMF_PA_HIGH_MOTION_QUALITY_BOOST_MODE` and `AMF_PA_TAQ_MODE` take effect only when `AMF_PA_LOOKAHEAD_BUFFER_DEPTH` is set to nonzero numbers.

2.1 Input / Output Format

The input / output is handled by the AMF Encoder component. No special setting is needed for AMF PA.

2.2 Properties

Table 1 provides the detailed description of the available parameters in AMF PA encoder mode.

Name	Type	Values	Default Value	Description
<code>AMF_PA_ENGINE_TYPE</code>	<code>AMF_MEMORY_TYPE</code>	<code>AMF_MEMORY_DX11</code> <code>AMF_MEMORY_OPENCL</code>	<code>AMF_MEMORY_OPENCL</code>	Determines what type of kernel PA uses.
<code>AMF_PA_ACTIVITY_TYPE</code>	<code>AMF_PA_ACTIVITY_TYPE_ENUM</code>	<code>AMF_PA_ACTIVITY_Y</code> <code>AMF_PA_ACTIVITY_YUV</code>	<code>AMF_PA_ACTIVITY_Y</code>	Determines whether activity analysis is performed on the Luma component only (Y) or on both Luma and Chroma (YUV).
<code>AMF_PA_SCENE_CHANGE_DETECTION_ENABLE</code>	bool	true false	true	Enables scene change detection
<code>AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY</code>	<code>AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_ENUM</code>	<code>AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_LOW</code> <code>AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_MEDIUM</code> <code>AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_HIGH</code>	<code>AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_MEDIUM</code>	Sensitivity of scene change detection. The higher the sensitivity, the more restrictive it is to detect a scene change. This parameter takes effect only when <code>AMF_PA_LOOKAHEAD_BUFFER_DEPTH</code> is set to 0.
<code>AMF_PA_STATIC_SCENE_DETECTION_ENABLE</code>	bool	true false	false	Enables static scene detection. A frame in a static scene will be encoded as a skip frame if the reference frame quality is acceptable. Refer to <code>AMF_PA_MAX_QP_BEFORE_FORCE_SKIP</code> for details.
<code>AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY</code>	<code>AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_ENUM</code>	<code>AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_LOW</code> <code>AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_MEDIUM</code> <code>AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_HIGH</code>	<code>AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_HIGH</code>	Sensitivity of static scene detection. The higher the sensitivity, the more restrictive it is to detect a static scene.
<code>AMF_PA_INITIAL_QP_AFTER_SCENE_CHANGE</code>	amf_uint64	0 – 51	0	The QP value that is used immediately after a scene change. When this parameter value equals 0, PA will automatically calculate a QP value for the new scene.
<code>AMF_PA_MAX_QP_BEFORE_FORCE_SKIP</code>	amf_uint64	0 – 51	35	To maintain acceptable encoding quality, a static frame is allowed to be encoded as a skip frame only when the average QP value across the blocks of the previously-encoded frame is less than or equal to this value/threshold.
<code>AMF_PA_CQ_STRENGTH</code>	<code>AMF_PA_CQ_STRENGTH_ENUM</code>	<code>AMF_PA_CQ_STRENGTH_LOW</code> <code>AMF_PA_CQ_STRENGTH_MEDIUM</code> <code>AMF_PA_CQ_STRENGTH_HIGH</code>	<code>AMF_PA_CQ_STRENGTH_MEDIUM</code>	Content Adaptive Quantization strength. Stronger CAQ strength means larger variation in block level QP assignment.

Name	Type	Values	Default Value	Description
AMF_PA_FRAME_SAD_ENABLE	bool	true false	true	Enables Frame SAD algorithm.
AMF_PA_LTR_ENABLE	bool	true false	false	Enables automatic long term reference frame management. Last frame of a scene will be saved as LTR frame and used as reference when a similar frame occurs again.
AMF_PA_LOOKAHEAD_BUFFER_DEPTH	amf_uint64	0 - MAX_LOOKAHEAD_DEPTH	0	Sets the PA lookahead buffer size. The longer the buffer depth, the better the quality and the longer the latency.
AMF_PA_PAQ_MODE	AMF_PA_PAQ_MODE_ENUM	AMF_PA_PAQ_MODE_NONE AMF_PA_PAQ_MODE_CAQ	AMF_PA_PAQ_MODE_NONE	Sets the perceptual adaptive quantization mode.
AMF_PA_TAQ_MODE	AMF_PA_TAQ_MODE_ENUM	AMF_PA_TAQ_MODE_NONE AMF_PA_TAQ_MODE_1 AMF_PA_TAQ_MODE_2	AMF_PA_TAQ_MODE_NONE	Sets the temporal adaptive quantization mode. MODE_1 is suitable for non-gaming applications whereas MODE_2 is suitable for gaming applications.
AMF_PA_HIGH_MOTION_QUALITY_BOOST_MODE	AMF_PA_HIGH_MOTION_QUALITY_BOOST_MODE_ENUM	AMF_PA_HIGH_MOTION_QUALITY_BOOST_MODE_NONE AMF_PA_HIGH_MOTION_QUALITY_BOOST_MODE_AUTO	AMF_PA_HIGH_MOTION_QUALITY_BOOST_MODE_NONE	Sets the PA high motion quality boost mode to help the encoder in motion search.

Table 1. AMF PA properties in encoder mode

2.3 Sample Application

The TranscodeHW sample application in the SDK package illustrates how to setup and run AMF PA component in its encoder mode. It calculates the activity maps of the transcoder input and guides the succeeding encoding process. To enable the PA process in the encoder pipeline, use the command line parameter “-EnablePreAnalysis true”. Below is an example cmd line enabling PA: *TranscodeHW.exe -input input.mp4 -output output.mp4 -width 1920 -height 1080 -usage transcoding -qualitypreset quality -targetBitrate 5000000 -frames 1000 -engine dx11 -EnablePreAnalysis true*

3 AMF PA - Standalone Mode

The standalone AMF PA component analyzes incoming video frames and produces an activity map for each video frame. Users also have the options to turn on the scene change detection and static scene detection features, in which cases AMF PA will return the scene change detection and/or static scene detection flags for the input frame.

3.1 Input / Output Format

The standalone AMF PA component accepts AMF_SURFACE_R32 surfaces as input and produces activity maps also stored in AMF_SURFACE_R32 surfaces. The resulting activity maps consist of one activity value (32-bit unsigned) for each 16x16 pixel block. The resulting activity map and scene change/static scene flags will be attached to the video frame structure.

3.2 Properties

Table 2 provides the detailed descriptions of the available parameters in AMF PA standalone mode.

Name	Type	Values	Default Value	Description
AMF_PA_ENGINE_TYPE	AMF_MEMORY_TYPE	AMF_MEMORY_DX11 AMF_MEMORY_OPENCL	AMF_MEMORY_OPENCL	Determines what type of kernel PA uses.
AMF_PA_ACTIVITY_TYPE	AMF_PA_ACTIVITY_TYPE_ENUM	AMF_PA_ACTIVITY_Y AMF_PA_ACTIVITY_YUV	AMF_PA_ACTIVITY_Y	Determines whether activity analysis is performed on the Luma component only (Y) or on both Luma and Chroma (YUV).
AMF_PA_SCENE_CHANGE_DETECTION_ENABLE	bool	true false	true	Enable scene change detection
AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY	AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_ENUM	AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_LOW AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_MEDIUM AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_HIGH	AMF_PA_SCENE_CHANGE_DETECTION_SENSITIVITY_MEDIUM	Sensitivity of scene change detection. The higher the sensitivity, the more restrictive it is to detect a scene change.
AMF_PA_STATIC_SCENE_DETECTION_ENABLE	bool	true false	false	Enable static scene detection.
AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY	AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_ENUM	AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_LOW AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_MEDIUM AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_HIGH	AMF_PA_STATIC_SCENE_DETECTION_SENSITIVITY_HIGH	Sensitivity of static scene detection. The higher the sensitivity, the more restrictive it is to detect a static scene.
AMF_PA_ACTIVITY_MAP	AMFSurface*	int32	N/A	Activity map calculated for the input image where each value corresponds to one block. Properties set by PA on output buffer interface.
AMF_PA_SCENE_CHANGE_DETECT	bool	true false	N/A	Scene change detection result. When this flag is true, it means the PA has identified the frame as a scene change. Properties set by PA on output buffer interface.
AMF_PA_STATIC_SCENE_DETECT	bool	true false	N/A	Static scene detection result. When this flag is true, it means the PA has identified the frame as a static scene. Properties set by PA on output buffer interface.

Table 2. AMF PA properties in standalone mode

3.3 Sample Application

The SimplePA sample application in the AMF SDK package illustrates how to setup and run AMF PA component in standalone mode. It calculates the activity maps of machine-generated video surfaces and dumps it into a binary file.

Annex A: Glossary of Acronyms

AMF	Advanced Media Framework
PA	Pre-Analysis
CAQ	Content Adaptive Quantization
PAQ	Perceptual Adaptive Quantization
TAQ	Temporal Adaptive Quantization
SAD	Sum of absolute difference
LTR	Long Term Reference