Advanced Micro Devices

Advanced Media Framework – h.264 Video Encoder

Programming Guide

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Contents

1 Introduction

1.1 Scope

This document provides a complete description of the AMD Advanced Media Framework (AMF) Video Encoder Component. This component exposes the AMD Video Compression Engine (VCE), which provides hardware accelerated H.264 video encoding functionality.

Figure 1 provides a system overview of the AMF Video Encoder Component.

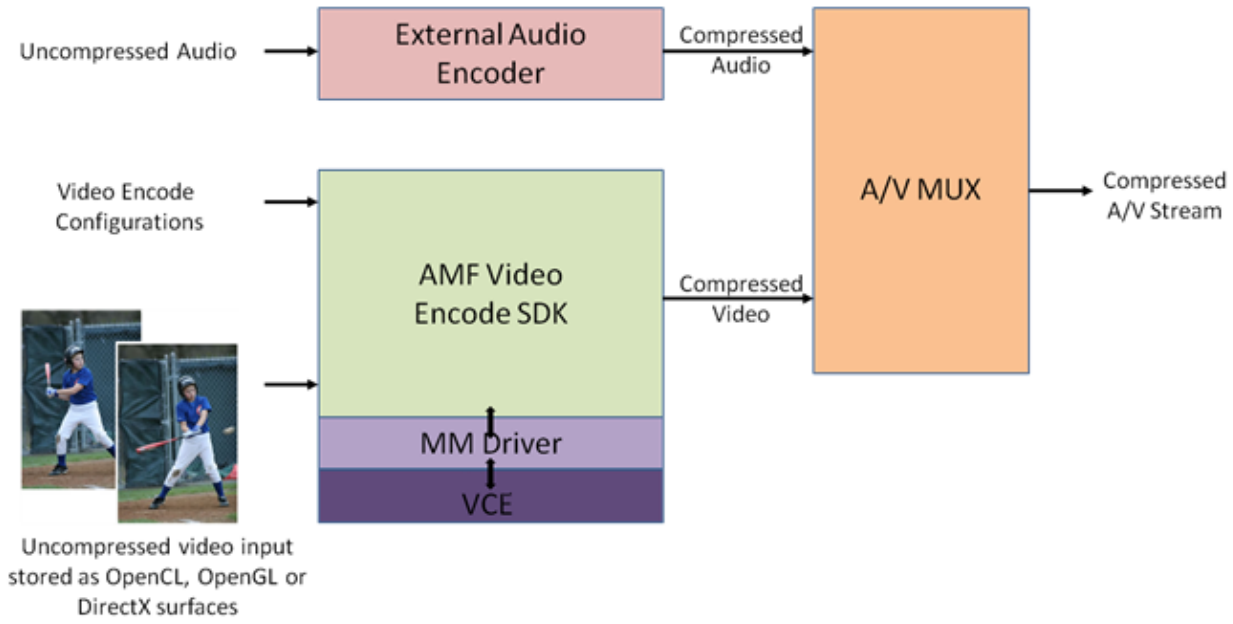

Figure 1 — System overview of the AMF Video Encode SDK

The AMF Video Encoder Component compresses RAW uncompressed video to an H.264 elementary bitstream.

The component does not provide a mechanism to handle audio compression, or stream multiplexing.

The component provides four different sets of pre-defined usages, which provide a convenient way for developers to configure the encoder to match the intended application use case. Advanced developers can also adjust encoding parameters to tailor the behavior to their specific application requirements.

1.2 Pre-defined Encoder Usages

The following table provides a brief overview of the encoding usage modes that have been defined:

Usage Mode	Intended use-cases	Comments
Transcoding	Transcoding, video editing	Favor compression efficiency and throughput over latency.
Ultra-low latency	Video game streaming	Optimize for extremely low latency use cases (e.g. cap the number of bits per frame), to enable high-interactivity applications.
Low Latency	Video collaboration, remote desktop	Optimize for low latency scenarios but allow occasional bitrate overshoots to preserve quality.
Webcam	Video conferencing	Optimize for a low-latency video conferencing scenario.
HQ	High quality mode	Optimize for best subjective video quality with possible loss of performance
HQLL	High quality low latency mode	Optimize for good quality with low latency

Note: User can override the default settings for these pre-defined usages in Table A-3. Default values of parameters.

2 AMF Video Encoder VCE-AVC Component

The AMF Video Encoder VCE-AVC component provides hardware accelerated AVC/SVC encoding using AMD's VCE.

To instantiate the AMF Video Encoder component, call the *AMFFactory::CreateComponent* method passing *AMFVideoEncoderVCE_AVC* or *AMFVideoEncoderVCE_SVC* component IDs defined in the *public/include/components/VideoEncoderVCE.h* header.

2.1 Input Submission and Output Retrieval

The AMF Video Encoder component accepts *AMFSurface* objects as input and produces *AMFBuffer* objects for output.

In the Transcoding mode the encoder needs to accept at least 3 input frames before any output is produced. In low latency modes output becomes available as soon as the first submitted frame is encoded.

2.2 Encode Parameters

Annex A provides the detailed description of encoding parameters (i.e., encoder properties) exposed by the Video Encoder VCE-AVC component for the following four usages:

- Transcoding mode,
- Ultra-low latency mode,
- Low Latency mode, and
- Webcam mode.

All properties are accessed using the *AMFPropertyStorage* interface of the Encoder object.

2.2.1 Static Properties

Static properties (e.g., profile, level, usage) must be defined before the `Init()` function is called, and will apply until the end of the encoding session.

2.2.2 Dynamic Properties

All dynamic properties have default values. Several properties can be changed subsequently and these changes will be flushed to encoder only before the next `Submit()` call.

2.2.3 Frame Per-Submission Properties

Per submission properties are applied on a per frame basis. They can be set optionally to force a certain behavior (e.g., force frame type to IDR) by updating the properties of the `AMFSurface` object that is passed through the `AMFComponent::Submit()` call.

2.2.4 SVC Properties

Scalable Video Coding (SVC) is enabled by setting `AMF_VIDEO_ENCODER_NUM_TEMPORAL_ENHANCMENT_LAYERS` to a value that is greater than 1. `AMF_VIDEO_ENCODER_NUM_TEMPORAL_ENHANCMENT_LAYER` is a dynamic property and can be changed at any time during an encoding session. To ensure proper support on Radeon RX 5000 Series or newer GPUs and Ryzen 2000 U/H series or newer APUs, `AMF_VIDEO_ENCODER_MAX_NUM_TEMPORAL_LAYERS` needs to be set before initializing the encoder to a value that is not smaller than the number of temporal enhancement layers. As an example, the maximum number of temporal layers shall be set to 4 if the number of temporal enhancement layers will be changed from 3 to 4 in an encoding session. The maximum number of temporal layers supported by the encoder can be queried from the encoder capabilities before initializing the encoder.

To define SVC parameters per layer, the following format must be used:

```
TL<Temporal_Layer_Number>.QL<Quality_Layer_Number>.<Parameter_name>
```

As an example with two temporal layers, to configure “Target bitrate” for the base/first temporal layer and first quality layer, the following parameter should be used:

```
“TL0.QL0.TargetBitrate”
```

To configure “Target bitrate” for the second temporal layer and first quality layer, the following parameter should be used:

```
“TL1.QL0.TargetBitrate”
```

When setting per layer parameters, the equivalent non-SVC layer parameters should not be set for the encoder otherwise the per layer configuration will be overwritten.

Remark: quality layers are not supported on VCE 1.0. “QL0” must be used for quality layers.

2.2.5 ROI Feature

Region of importance (ROI) feature provides a way to specify the relative importance of the macroblocks in the video frame. Encoder will further adjust the bits allocation among code blocks based on the importance, on top of the base rate control decisions. More important blocks will be encoded with relatively better quality.

The ROI map can be attached to the input frame on a per frame basis. Currently, the ROI map can only use system memory. The ROI map includes the importance values of each macro block, ranging from 0 to 10, stored in 32bit unsinged format. Refer to SimpleROI sample application for further implementation details.

2.2.6 Encoder Statistics Feedback

If an application sets the `AMF_VIDEO_ENCODER_STATISTICS_FEEDBACK` flag on for an input picture, the encoder will feedback to the application statistics for this specific picture. After the encoding ends, the application can retrieve by name the specific statistic(s) it is interested in. The supported encoder statistics are listed in Table A-4. This feature is supported by Radeon RX 5000 Series or newer GPUs as well as Ryzen 2000 U/H series or newer APUs.

2.2.7 Picture Transfer Mode

If an application enables `AMF_VIDEO_ENCODER_PICTURE_TRANSFER_MODE` for a specific input picture, it can dump out the reconstructed picture after encoding and/or it can inject a picture to be used as the reference picture during the encoding. It is worth noting that reference picture injection is a feature that is intended for advanced algorithm testing and exploration. It needs to be used with care since the internal DPB in the current encoding session will be overridden by the injected reference picture(s). The reader can refer to SimpleFrameInjection sample application for further implementation details. This feature is supported by Radeon RX 5000 Series or newer GPUs as well as Ryzen 2000 U/H series or newer APUs.

3 Sample Applications

The AMF Encoder Sample application show how to setup and use the AMF Video Encoder VCE-AVC Component to encode video frames that are loaded from disk or rendered by the DirectX 3D engine.

3.1 List of Parameters

Sample applications support almost all visible encoder parameters (except PictureStructure, EndOfSequence, EndOfStream) and few additional parameters.

Additional parameters of VCEEncoderRaw application:

Category	Name	Values	Description
Miscellaneous parameters	ApplyTo	Frame number	Forces all subsequent configuration parameters to be applied to a specific frame
	Input	File name, relative or absolute path	Input file with frames (YUV420, NV12 or BGRA)
	Output	File name, relative or absolute path	Output H.264 file for encoded data
	DX9	Flag (without any values)	Forces Direct3D 9 (default Direct3D 11)
	OpenCL	Flag (without any values)	Forces OpenCL
	MTMode	Flag (without any values)	Enables creating or reading from file of frames in separate thread.
	PerfStat	Flag (without any values)	Enables showing a performance statistic

Additional parameters of VCEEncoderD3D application:

Category	Name	Values	Description
Miscellaneous parameters	Frames	Number of frames to be encoded	Number of frames to be encoded
	ApplyTo	Frame number	Forces all subsequent configuration parameters to be applied to a specific frame
	Output	File name, relative or absolute path	Output H.264 file for encoded data
	DX9	Flag (without any values)	Use Direct3D 9 (default Direct3D 11) for rendering
	DX9EX	Flag (without any values)	The same as DX9 but using Device9Ex instead Device9
	OpenGL	Flag (without any values)	Use OpenGL for rendering
	Windowmode	Flag (without any values)	Shows rendering window for D3D sample application
	MTMode	Flag (without any values)	Enables creating or reading from file of frames in separate thread. Doesn't work for OpenGL.
	PerfStat	Flag (without any values)	Enables showing a performance statistic

3.2 Command line example

3.2.1 Transcoding application (TranscodingHW.exe)

```
VCEEncoderRaw.exe -input input.h264 -output out.h264 -width 1280 -height 720 -usage
transcoding -rateControlMethod cbr -targetBitrate 500000 -targetBitrate 100000
```

This command transcodes H264 elementary stream to H.264 video. Encoder is created with “Transcoding” usage.

3.2.2 D3D application (VCEEncoderD3D.exe)

```
VCEEncoderD3D.exe -output VideoSample_1024x768.h264 -width 1024 -height 768 -usage
transcoding - rateControlMethod cbr -targetBitrate 500000 -frames 400
```

This command encodes 400 frames through D3D renderer and creates an output file with the encoded data. Encoder is created with “Transcoding” usage. Initial configuration sets bitrate to a value of 500kbits/sec.

Annex A: Encoding & frame parameters description

Table A-1. Encoder configuration parameters

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Values	Description
Encoder initialization parameters	USAGE	0, 1, 2, 3, 4, 5 (Transcoding, UltraLowLatency, LowLatency, Webcam, HQ(high quality), HQLL(high quality low latency)	Selects the AMF usage (see Section 1.2)
	INSTANCE_INDEX	0,1	Selects the encoder engine used for encoding
	PROFILE	66, 77, 100 (Baseline, Main, High)	Selects the H.264 profile
	PROFILE_LEVEL	1, 1.1, 1.2, 1.3, 2, 2.1, 2.2, 3, 3.1, 3.2, 4, 4.1, 4.2	Selects the H.264 profile level
	MAX_LTR_FRAMES	0 … 2	The number of long-term references controlled by the user. Remarks: • When == 0, the encoder may or may not use LTRs during encoding. • When >0, the user has control over all LTR. • With user control of LTR, B-pictures and Intra-refresh features are not supported. • The actual maximum number of LTRs allowed depends on H.264 Annex A Table A-1 Level limits, which defines dependencies between the H.264 Level number, encoding resolution, and DPB size. The DPB size limit impacts the maximum number of LTR allowed.
	LTR_MODE	0, 1 (Reset unused, keep unused) Default = 0	Removes/keeps unused LTRs not specified inside the LTR reference bitfield.
	LOWLATENCY_MODE	True/False (On/Off); default is false	Enables low latency mode in the encoder and switches POC mode to 2
	FRAMESIZE	Width: 64 – 4096 Height: 64 – 4096	Frame width and height in pixels, maximum values are hardware-specific, should be queried through *AMFCaps*
	ASPECT_RATIO	Default 1:1	Pixel aspect ratio
	MAX_CONSECUTIVE_BPICTURES	0~3	Maximum number of consecutive B Pictures, suggestion set to 3 if AMF_VIDEO_ENCODER_B_PIC_PATTERN is not 0.
	ADAPTIVE_MINIGOP	0 or 1	bool; default = 0; Disable/Enable Adaptive MiniGOP, can enable with PA enabled.
	PRE_ANALYSIS_ENABLE	bool; default = false; enables the pre-analysis module. Refer to AMF Video PreAnalysis API reference for more details.	Some encoder properties require this property been set.
	COLOR_BIT_DEPTH	8, 10, 16	Sets the number of bits in each pixel's color component in the encoder's compressed output bitstream. Default is 8.
	MAX_NUM_TEMPORAL_LAYERS **	1 … Maximum number of temporal layers supported	Sets the maximum number of temporal layers. It shall not be exceeded by the number of temporal enhancement layers. The maximum number of temporal layers supported is determined by the corresponding encoder capability.

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Values	Description
Encoder color conversion parameters	INPUT_COLOR_PROFILE	UNKNOWN, 601, 709, 2020, JPEG, FULL_601, FULL_709, FULL_2020	Color profile of the input surface. SDR - Setting this parameter (COLOR_PROFILE) can fully describe a surface for SDR use case. HDR – For HDR use case the TRANSFER_CHARACTERISTIC, COLOR_PRIMARIES, and NOMINAL_RANGE parameters describe the surface. See ColorSpace.h for enumeration.
	INPUT_TRANSFER_CHARACTERISTIC	UNDEFINED, BT709, UNSPECIFIED, RESERVED, GAMMA22, GAMMA28, SMPTE170M, SMPTE240M, LINEAR, LOG, LOG_SQRT, IEC61966_2_4, BT1361_ECG, IEC61966_2_1, BT2020_10, BT2020_12, SMPTE2084, SMPTE428, ARIB_STD_B67	Characteristic transfer function of the input surface used to perform the mapping between linear light components (tristimulus values) and a nonlinear RGB signal. Used (alongside COLOR_PRIMARIES and NOMINAL_RANGE parameters) to describe surface in HDR use case. See ColorSpace.h for enumeration.
	INPUT_COLOR_PRIMARIES	UNDEFINED, BT709, UNSPECIFIED, RESERVED, BT470M, BT470BG, SMPTE170M, SMPTE240M, FILM, BT2020, SMPTE428, SMPTE431, SMPTE432, JEDEC_P22	Color space primaries for the input surface which are the maximum red, green, and blue value permitted within the color space. Used (alongside TRANSFER_CHARACTERISTIC and NOMINAL_RANGE parameters) to describe surface in HDR use case. See ColorSpace.h for enumeration.
	OUTPUT_COLOR_PROFILE	UNKNOWN, 601, 709, 2020, JPEG, FULL_601, FULL_709, FULL_2020	Color profile of the compressed output stream. SDR - Setting this parameter (COLOR_PROFILE) can fully describe a surface for SDR use case. HDR – For HDR use case the TRANSFER_CHARACTERISTIC, COLOR_PRIMARIES, and NOMINAL_RANGE parameters describe the surface. See ColorSpace.h for enumeration. Determines the optional VUI parameter "matrix_coefficients".
	OUTPUT_TRANSFER_CHARACTERISTIC	UNDEFINED, BT709, UNSPECIFIED, RESERVED, GAMMA22, GAMMA28, SMPTE170M, SMPTE240M, LINEAR, LOG, LOG_SQRT, IEC61966_2_4, BT1361_ECG, IEC61966_2_1, BT2020_10, BT2020_12, SMPTE2084, SMPTE428, ARIB_STD_B67	Characteristic transfer function of the compressed output stream used to perform the mapping between linear light components (tristimulus values) and a nonlinear RGB signal. Used (alongside COLOR_PRIMARIES and NOMINAL_RANGE parameters) to describe surface in HDR use case. See ColorSpace.h for enumeration.
	OUTPUT_COLOR_PRIMARIES	UNDEFINED, BT709, UNSPECIFIED, RESERVED, BT470M, BT470BG, SMPTE170M, SMPTE240M, FILM, BT2020, SMPTE428, SMPTE431, SMPTE432, JEDEC_P22	Color space primaries for the compressed output surface which are the maximum red, green, and blue value permitted within the color space. Used (alongside TRANSFER_CHARACTERISTIC and NOMINAL_RANGE parameters) to describe surface in HDR use case. See ColorSpace.h for enumeration.
	TARGET_BITRATE	10 000 - 100 000 000 bit/s	Sets the target bitrate
	PEAK_BITRATE	10 000 - 100 000 000 bit/s	Sets the peak bitrate

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Values	Description
Encoder rate-control parameters	RATE_CONTROL_METHOD	0, 1, 2, 3, 4, 5, 6 (CQP, CBR, VBR, VBR_LAT, QVBR, HQVBR, HQCBR)	Selects the rate control method: • CQP – Constrained QP, • CBR - Constant Bitrate, • VBR - Peak Constrained VBR, • VBR_LAT - Latency Constrained VBR, • QVBR – Quality VBR • HQVBR – High Quality VBR • HQCBR – High Quality CBR Remarks: • When SVC encoding is enabled, some rate-control parameters can be configured differently for a particular SVC-layer. An SVC-layer is denoted by an index pair [SVC-Temporal Layer index][SVC-Quality Layer index]. E.g. The bitrate may be configured differently for SVC-layers [0][0] and [1][0]. • We restrict all SVC layers to have the same Rate Control method. Some RC parameters are not enabled with SVC encoding (e.g. all parameters related to B-pictures). • QVBR, HQVBR and HQCBR are only supported if PreAnalysis is enabled. • QVBR, HQVBR and HQCBR target improving subjective quality with the possible loss of objective quality (PSNR or VMAF).
	RATE_CONTROL_SKIP_FRAME_ENABLE	True/False (On/Off)	Enables skip frame for rate control
	MIN_QP	0 – 51	Sets the minimum QP
	MAX_QP	0 – 51	Sets the maximum QP
	QP_I	0 – 51	Sets the constant QP for I-pictures. Remarks: • Only available for CQP rate control method.
	QP_P	0 – 51	Sets the constant QP for P-pictures. Remarks: • Only available for CQP rate control method.
	QP_B	0 – 51	Sets the constant QP for B-pictures. Remarks: • Only available for CQP rate control method.
	QVBR_QUALITY_LEVEL	1 – 51	Sets the quality level for QVBR rate control method. Remarks: • Only available for QVBR rate control method.
	FRAMERATE	1*FrameRateDen … 120* FrameRateDen	Frame rate numerator
	VBV_BUFFER_SIZE	1000 – 100 000 000	Sets the VBV buffer size in bits
	INITIAL_VBV_BUFFER_FULLNESS	0 - 64	Sets the initial VBV buffer fullness
	ENFORCE_HRD	True/False (On/Off)	Disables/enables constraints on QP variation within a picture to meet HRD requirement(s)

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Values	Description
	ENABLE_VBAQ	True/False (On/Off)	Enables/disables VBAQ VBAQ stands for "Variance Based Adaptive Quantization". The basic idea of VBAQ: Human visual system is typically less sensitive to artifacts in highly textured area. In VBAQ mode, we use pixel variance to indicate the complexity of spatial texture. This allows us to allocate more bits to smoother areas. Enabling such feature leads to improvements in subjective visual quality with some content.
	MAX_AU_SIZE	0 - 100 000 000 bits	Maximum AU size in bits
	B_PIC_DELTA_QP *	-10 ... 10	Selects the delta QP of non-reference B pictures with respect to I pictures
	REF_B_PIC_DELTA_QP *	-10 ... 10	Selects delta QP of reference B pictures with respect to I pictures
	PREENCODE_ENABLE	AMF_VIDEO_ENCODER_PREENCODE_DISABLED, AMF_VIDEO_ENCODER_PREENCODE_ENABLED	Enables or disables rate control pre-analysis, default is Disabled
	FILLER_DATA_ENABLE	True/False	Enables/disables filler data to maintain constant bit rate
Encoder picture-control parameters	HEADER_INSERTION_SPACING	0 … 1000	Sets the headers insertion spacing
	IDR_PERIOD	0 ... 1000	Sets IDR period. IDRPeriod= 0 turns IDR off
	DE_BLOCKING_FILTER	True/False (On/Off)	Enable/disable the de-blocking filter
	INTRA_REFRESH_NUM_MBS_PER_SLOT	0 - #MBs per frame	Sets the number of intra-refresh macro-blocks per slot
	SLICES_PER_FRAME	1 - #MBs per frame	Sets the number of slices per frame
	B_PIC_PATTERN *	0, 1, 2, 3	Sets the number of consecutive B-pictures in a GOP. BPicturesPattern = 0 indicates that B-pictures are not used
	B_REFERENCE_ENABLE *	True/False (On/Off)	Enables or disables using B-pictures as references
	CABAC_ENABLE	AMF_VIDEO_ENCODER_UNDEFINED, AMF_VIDEO_ENCODER_CABAC, AMF_VIDEO_ENCODER_CALV	Encoder coding method, when Undefined is selected, the behavior is profile-specific: CALV for Baseline, CABAC for Main and High
	MAX_NUM_REFRAMES	0..16	Maximum number of reference frames
	HIGH_MOTION_QUALITY_BOOST_ENABLE	bool; default = depends on USAGE;	Enable High motion quality boost mode. It pre-analysis the motion of the video and use the information for better encoding.
Encoder miscellaneous parameters	SCANTYPE	0, 1 (Progressive, Interlaced)	Selects progressive or interlaced scan
	QUALITY_PRESET	0, 1, 2 (Balanced, Speed, Quality)	Selects the quality preset
	FULL_RANGE_COLOR	True/False	True indicates that the YUV range is 0..255
	MAX_INSTANCES	1 or 2	Hardware-dependent, only some hardware supports 2 instances
	MULTI_INSTANCE_MODE	True or False	Enables or disables multi-instance mode, default - disabled
	CURRENT_QUEUE	0 or 1	Selects the encoder instance frames are being submitted to
	PICTURE_TRANSFER_MODE	AMF_VIDEO_ENCODER_PICTURE_TRANSFER_MODE_ON, AMF_VIDEO_ENCODER_PICTURE_TRANSFER_MODE_OFF	The application can turn on this flag for a specific input picture to allow dumping the reconstructed picture and/or injecting a reference picture
	QUERY_TIMEOUT	default = 0 (no wait)	timeout for QueryOutput call in ms.
	PSNR_FEEDBACK	Default = 0	Signal encoder to calculate PSNR score
	SSIM_FEEDBACK	Default = 0	Signal encoder to calculate SSIM score
	BLOCK_QP_FEEDBACK	Default = 0	Signal encoder to collect and feedback block level QP values

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Values	Description
Encoder motion estimation parameters	MOTION_HALF_PIXEL	True/False (On/Off)	Turns on/off half-pixel motion estimation
	MOTION_QUARTERPIXEL	True/False (On/Off)	Turns on/off quarter-pixel motion estimation
Encoder SVC parameters	NUM_TEMPORAL_ENHANCMENT_LAYERS	1 … Maximum number of temporal layers supported	Sets the number of temporal enhancement layers. SVC with temporal scalability is enabled when the number of layers is greater than 1. The maximum number of temporal layers supported is determined by the corresponding encoder capability. Remarks: • Actual modification of the number of temporal enhancement layers will be delayed until the start of the next temporal GOP. • B-pictures and Intra-refresh features are not supported with SVC.
Encoder SVC per-layer parameters	TL<TL_Num>. QL<QL_Num>. <Parameter_name>	Parameter-specific values	Configures rate-control parameter per SVC layer. • TL_Num — temporal layer number • QL_Num — quality layer number • Parameter_name — rate-control parameter name (see below) Rate-control parameters supported • TargetBitrate • PeakBitrate • VBVBufferSize • FrameRate • MinQP • MaxQP • QPI • QPP • FillerDataEnable • RateControlSkipFrameEnable • EnforceHRD • MaxAUSize (Refer to rate-control parameters section of this table for more details) Remarks: • Quality layers are not supported on VCE 1.0. "QL0" must be used for quality layers.

* this feature is not supported by VCE 1.0

** this property is not supported on GPUs prior to Radeon RX 5000 Series or APUs prior to Ryzen 2000 U/H series.

Table A-2. Input frame and encoded data parameters

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Values	Description
Frame per-submission parameters	INSERT_SPS	True/False (On/Off)	Inserts SPS
	INSERT_PPS	True/False (On/Off)	Inserts PPS
	INSERT_AUD	True/False (On/Off)	Inserts AUD
	PICTURE_STRUCTURE	0, 1, 2, 3 (None, Frame, TopField, BottomField)	Picture structure

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Values	Description
	FORCE_PICTURE_TYPE	0, 1, 2, 3, 4, 5* (NONE, SKIP, IDR, I, P, B*)	Forces the picture type (to use this feature, set AMF_VIDEO_ENCODER_IDR_PERIOD to 0)
	END_OF_SEQUENCE	True/False (On/Off)	End of sequence
	END_OF_STREAM	True/False (On/Off)	End of stream
	MARK_CURRENT_WITH_LTR_INDEX	-1 … (MaxOfLTRFrames -1)	If != -1, the current picture is coded as a long-term reference with the given index. Remarks: • When the user controls N LTRs (using the corresponding Create parameter), then the LTR Index the user can assign to a reference picture varies from 0 to N-1. By default, the encoder will "use up" available LTR Indices (i.e. assign them to references) even if the user does not request them to be used. • When LTR is used with SVC encoding, only base temporal layer pictures can be coded as LTR. In this case, the request to mark the current picture as LTR would be delayed to the next base temporal layer picture if the current picture is in an enhancement layer. If the user submits multiple requests to mark current as LTR between base temporal layer pictures, then only the last request is applied.
	FORCE_LTR_REFERENCE_BITFIELD	Bitfield (MaxOfLTRFrames (max possible 16 bits))	Force LTR Reference allowed bitfield. If == 0, the current picture should predict from the default reference. If != 0, the current picture should predict from one of the LTRs allowed by the bitfield (bit# = LTR Index#). Remarks: • E.g. if Bit#0 = 1, then the existing LTR with LTR Index = 0 may be used for reference. The bitfield may allow more than one LTR for reference, in which case the encoder is free to choose which one to use. This bitfield also disallows existing LTRs not enabled by it from current/future reference. • E.g. if Bit#1 = 0, and there is an existing reference with LTR Index = 1, then this LTR Index will not be used for reference until it is replaced with a newer reference with the same LTR Index.

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Values	Description
	ROI_DATA	Video surface in AMF_SURFACE_GRAY32 format	Important value for each macro block ranges from 0 to 10, stored in 32bit unsigned format.
	STATISTICS_FEEDBACK	True/False (On/Off)	Instruct encoder to collect and feedback statistics
	REFERENCE_PICTURE	AMFSurface	Injected reference picture. Valid with AMF_VIDEO_ENCODER_PICTURE_TRANSFER_MODE turned on
Encoded data parameters	OUTPUT_DATA_TYPE	0, 1, 2, 3* (IDR, I, P, B*)	Type of encoded data
	OUTPUT_MARKED_LTR_INDEX	-1 … (MaxOfLTRFrames -1)	Marked as LTR Index. If != -1, then this picture was coded as a long-term reference with this LTR Index.
	OUTPUT_REFERENCED_LTR_INDEX_BITFIELD	Bitfield (MaxOfLTRFrames (max possible 16 bits))	Referenced LTR Index bitfield. If != 0, this picture was coded to reference long-term references. The enabled bits identify the LTR Indices of the referenced pictures (e.g. if Bit #0 = 1, then LTR Index 0 was used as a reference when coding this picture).
	OUTPUT_TEMPORAL_LAYER	0 … (Maximum number of temporal layers supported - 1)	Temporal layer of the encoded picture
	RECONSTRUCTED_PICTURE	AMFSurface	Reconstructed picture. Valid with AMF_VIDEO_ENCODER_PICTURE_TRANSFER_MODE turned on

* this feature is not supported by VCE 1.0

Table A-3. Default values of parameters

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Transcoding	Ultra low latency	Low latency	Webcam	HQ	HQLL
Initialization Parameters	PROFILE	Main	Main	Main	Main	High	High
	PROFILE_LEVEL	4.2	4.2	4.2	4.2	4.2	4.2
	MAX_NUM_TEMPORAL_LAYERS***	1	1	1	1	1	1
Rate control	TARGET_BITRATE	20 mbps	20 mbps	20 mbps	20 mbps	20 mbps	20 mbps
	PEAK_BITRATE	30 mbps	20 mbps	30 mbps	30 mbps	30 mbps	30 mbps
	MIN_QP	0	0	0	0	0	0
	MAX_QP	51	51	51	51	51	51
	QP_I	22	22	22	22	22	22
	QP_P	22	22	22	22	22	22
	QP_B	22	22	22	22	22	22
	FRAMERATE	30 fps	30 fps	30 fps	30 fps	30 fps	30 fps
	VBV_BUFFER_SIZE	20 mbits	735 kbits	4 mbits	2 mbits	40 mbits	10 mbits
	INITIAL_VBV_BUFFER_FULLNESS	64(64 means 100%)	64	64	64	64	64
	ENFORCE_HRD	false	true	false	false	false	false
	MAX_AU_SIZE	0	0	0	0	0	0
	FILLER_DATA_ENABLE	false	false	false	false	false	false
	B_PIC_DELTA_QP*	+4	0	+4	+4	+4	+4
	REF_B_PIC_DELTA_QP*	+2	0	+2	+2	+2	+2
	HEADER_INSERTION_SPACING**	0	0	0	0	0	0
	IDR_PERIOD	30	300	300	30	300	120
Picture Control	DE_BLOCKING_FILTER	true	true	true	true	true	true
	INTRA_REFRESH_NUM_MBS_PER_SLOT*	0	255	255	0	0	0

Category	Name (prefix "AMF_VIDEO_ENCODER_")	Transcoding	Ultra low latency	Low latency	Webcam	HQ	HQLL
	SLICES_PER_FRAME	1	1	1	1	1	1
	B_PIC_PATTERN*	3	0	0	0	3	0
	B_REFERENCE_ENABLE*	true	false	true	true	true	true
	SCANTYPE	0	0	0	0	0	0
	QUALITY_PRESET	Balanced	Speed	Speed	Speed	Quality	Quality
Motion estimation	MOTION_HALF_PIXEL	1	1	1	1	1	1
	MOTION_QUARTERPIXEL	1	1	1	1	1	1
SVC	NUM_TEMPORAL_ENHANCMENT_LAYERS***	1	1	1	1	1	1
New parameters	RATE_CONTROL_METHOD	PCVBR	LCVBR	PCVBR	PCVBR	QVBR/PCVBR	CBR
	ENABLE_VBAQ	off	off	off	off	on	on
	LOWLATENCY_MODE	off	on	off	off	off	on
	HIGH_MOTION_QUALITY_BOOST_ENABLE	off	off	off	off	on	on
	PREENCODE_ENABLE	off	off	off	off	on	off
	PRE_ANALYSIS_ENABLE	off	off	off	off	off	off
	MAX_LTR_FRAMES	0	0	0	0	0	0
	MAX_NUM_REFRAMES	4	4	4	4	4	4
	QUERY_TIMEOUT	0	0	0	0	50	50

* `BPicturesDeltaQP`, `ReferenceBPicturesDeltaQP`, `IntraRefreshNumMBsPerSlot`, `BPicturesPattern` and `BReferenceEnable` parameters are available only when:

- `MaxOfReferenceFrames` is greater than 1
- `NumOfLTR` is 0 (LTR is not used)

** HeaderInsertionSpacing: Every IDR frame has SPS and PPS regardless of default value of HeaderInsertionSpacing per VCE logic.

*** `NumOfTemporalEnhancmentLayers` shall not exceed `MaxNumOfTemporalLayers`. SVC is supported in all usages on Radeon RX 5000 Series or newer GPUs and Ryzen 2000 U/H series or newer APUs. It is only supported in Webcam usage on products prior to the aforementioned.

Table A-4. Encoder statistics feedback

Statistic Name (prefix "AMF_VIDEO_ENCODER_")	Description
STATISTIC_FRAME_QP	QP of the first encoded macroblocks in a picture
STATISTIC_AVERAGE_QP	Average QP of all encoded macroblocks in a picture
STATISTIC_MAX_QP	Max QP among all encoded macroblocks in a picture
STATISTIC_MIN_QP	Min QP among all encoded macroblocks in a picture
STATISTIC_PIX_NUM_INTRA	Number of intra-coded pixels
STATISTIC_PIX_NUM_INTER	Number of inter-coded pixels
STATISTIC_PIX_NUM_SKIP	Number of skip-coded pixels
STATISTIC_BITCOUNT_RESIDUAL	Frame level bit count of residual data
STATISTIC_BITCOUNT_MOTION	Frame level bit count of motion vectors
STATISTIC_BITCOUNT_INTER	Frame level bit count of inter macroblocks
STATISTIC_BITCOUNT_INTRA	Frame level bit count of intra macroblocks
STATISTIC_BITCOUNT_ALL_MINUS_HEADER	Frame level bit count of the bitstream excluding header
STATISTIC_MV_X	Accumulated absolute values of MVX
STATISTIC_MV_Y	Accumulated absolute values of MVY
STATISTIC_RD_COST_FINAL	Frame level final RD cost
STATISTIC_RD_COST_INTRA	Frame level RD cost for intra mode
STATISTIC_RD_COST_INTER	Frame level RD cost for inter mode

Statistic Name (prefix “AMF_VIDEO_ENCODER_”)	Description
STATISTIC_SATD_FINAL	Frame level final SATD
STATISTIC_SATD_INTRA	Frame level SATD for intra mode
STATISTIC_SATD_INTER	Frame level SATD for inter mode

Table A-5. Encoder PSNR/SSIM feedback

Statistic Name (prefix “AMF_VIDEO_ENCODER_”)	Description
STATISTIC_PSNR_Y	PSNR Y
STATISTIC_PSNR_U	PSNY U
STATISTIC_PSNR_V	PSNR V
STATISTIC_PSNR_ALL	PSNR YUV
STATISTIC_SSIM_Y	SSIM Y
STATISTIC_SSIM_U	SSIM U
STATISTIC_SSIM_V	SSIM V
STATISTIC_SSIM_ALL	SSIM YUV