Bit Rate Control

Application Notes

Issue 03

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About This Document

Purpose

This document describes the parameter meanings and usage rate algorithms. Some common issues of bit rate control are introduced, for example, the method for adjusting parameters in low bit rate scenarios.

Related Versions

The following table lists the product versions related to this document.

Product Name	Version
Hi3516A	V100R001
Hi3516D	V100R001
Hi3518E	V200R001
Hi3518E	V201R001
Hi3516C	V200R001
Hi3536	V100R001
Hi3521A	V100R001
Hi3520D	V300R001
Hi3531A	V100R001

Intended Audience

This document is intended for:

- Technical support engineers
- Board hardware development engineers

Change History

Updates between document issues are cumulative. Therefore, the latest document issue contains all updates made in previous issues.

Issue 03 (2016-10-28)

This issue is the third official release, which incorporates the following changes:

Chapter 1 Description and Usage of Bit Rate Control Parameters

Section 1.3 is added.

Chapter 2 Bit Rate Control

Section 2.6 is added.

Issue 02 (2015-06-09)

This issue is the second official release, which incorporates the following changes:

The contents related to Hi3518E V200, Hi3518E V201, Hi3516C V200, and the Hi3536 are added.

Chapter 1 Description and Usage of Bit Rate Control Parameters

In section 1.2, table 1-3 is modified.

Chapter 2 Bit Rate Control

Section 2.5 is added.

Issue 01 (2015-02-10)

This issue is the first official release.

Contents

Tables

1 Description and Usage of Bit Rate Control Parameters

1.1 Parameter Description and Usage of CBR

NOTE

Unless otherwise specified, this document applies to the Hi3516A, Hi3516D, Hi3518E V200/V201, Hi3536, and Hi3516CV200..

Unless otherwise stated, the contents of Hi3516C V200 are consistent with those of Hi3518E V200/Hi3518E V201.

Unless otherwise stated, the contents of Hi3520D V300 are consistent with those of Hi3521A V100.

Table 1-1 Attributes of CBR

Parameter	Description	Application Scenario	H.264	H.265
u32Gop	I frame interval Value range: [1, 65536]	This parameter is usually set to an integral multiple of the output frame rate.	-	Same as H.264
u32StatTime	Statistics time Unit: second Value range: [1, 60]	In common scenarios, this parameter can be set to the group of picture (GOP) or output frame rate. This parameter affects long-term steadiness of the bit rate. It can be set to a large value when short-term fluctuation is acceptable, for example, during storage based on digital video recorders (DVRs).	If this parameter is set to a larger value, the threshold for determining whether to re-encode frames is increased, the number of re-encoding times is decreased, and the bit rate fluctuation is increased.	Same as H.264
u32SrcFrmRate	Input frame rate Value range: [1, 240]	Frame rate control	-	Same as H.264

Parameter	Description	Application Scenario	H.264	H.265
fr32DstFrmRate	Output frame rate Value range: [1/16, 240]	Frame rate control	-	Same as H.264
u32BitRate	Target bit rate	-	-	Same as H.264
u32FluctuateLevel	Fluctuation level, set to **0** by default	-	Invalid	Same as H.264

Table 1-2 Advanced parameters of CBR (frame-level)

Parameter	Description	Application Scenario	H.264	H.265
u32MinIprop	Minimum IP ratio Default value: 1	The default value can be used in all scenarios.	The interface is invalid currently.	Same as H.264
u32MaxIprop	Maximum IP ratio Default value: 20	This parameter is used to control the I frame ratio and prevent the oversized I frame in still scenarios from causing the respiratory effect.	If the ratio of the I frame size to the P frame size is greater than **u32MaxIprop**, the quantization parameter (QP) of the I frame is increased to limit the I frame size.	Same as H.264
u32MaxQp	Maximum QP Recommended value range: [40, 51]	This parameter is used to control the lowest image quality. The QP is not increased any longer after being adjusted to this value, which may cause bit rate rise.	The parameter value is set to 51 in scenarios where the bit rate takes priority and set as required in scenarios where the quality takes priority.	Same as H.264
u32MinQp	Minimum QP Recommended value range: [10, 20]	This parameter is used to control the highest image quality. The QP is not decreased any longer after being adjusted to this value, which may cause bit rate insufficiency. This parameter is intended to reduce the bit rate in simple still scenarios.	-	-
u32MinIQp	Minimum QP of the I frame The preferable value in still scenarios with	This parameter is used to control the minimum QP of the I frame and the main purpose is to restrict the I	-	-

Parameter	Description	Application Scenario	H.264	H.265
	complex texture ranges from 20 to 25. It is recommended that the value of this parameter be equal to **u32MinQp** in normal scenarios.	frame ratio.		
s32IPQPDelta	QP difference of the IP frame, to address the respiratory effect	-	Default value: 6	Default value: 3
s32QualityLevel	Quality level Value range: [1, 5] Default value: 3 It is used to regulate the QP adjustment amplitude during scenario switchover, for example, switchover between motion and still scenarios. The increasing bit rate becomes normal after QP adjustment.	This parameter is set to **5** when the bit rate must be controlled. This parameter is set to **1** when the image quality must be improved.	The difference between the maximum value (5) of **s32QualityLevel** or the minimum value (1) of **s32QualityLevel** and the QP in actual application scenarios is 1 or 2.	Same as H.264
s32MaxReEncodeTimes	Maximum re-encoding times Value range: [0, 3] Default value: 2 Suggestion: Enable re-encoding to ensure the steadiness of the bit rate.	-	The default value applies to common scenarios.	Same as H.264

1.2 Parameter Description and Usage of VBR

Table 1-3 Attributes of VBR

Parameter	Description	Application Scenario	H.264	H.265
u32Gop	I frame interval Value range: [1, 65536]	This parameter is usually set to an integral multiple of the output frame rate.	-	Same as H.264
u32StatTime	Statistics time Unit: second Value range: [1, 60]	This parameter is consistent with the CBR.	If this parameter is set to a larger value, the threshold for determining whether to re-encode frames is increased, the number of re-encoding times is decreased, and the bit rate fluctuation is increased.	Same as H.264
u32SrcFrmRate	Input frame rate Value range: [1,240]	Frame rate control	-	Same as H.264
fr32DstFrmRate	Output frame rate Value range: [1/16,240]	Frame rate control	-	Same as H.264
u32MaxBitRate	Maximum bit rate	-	-	Same as H.264
u32MaxQp u32MinQp	QP set according to the bit rate and scenario: Preferable value: MinQP: 24–32 MaxQP: 40–51	The maximum QP restricts the image quality, while the minimum QP may affect the lowest bit rate of the VBR.	The value of **u32MaxQp** is fixed at 51. The image quality level can be adjusted by configuring **u32MinQp**.	Same as H.264

Table 1-4 Advanced parameters of VBR (frame-level)

Parameter	Description	Application Scenario	H.264	H.265
s32IPQPDelta	Same as the CBR parameter **s32IPQPDelta**	This parameter is used to address the respiratory effect.	None	None
s32ChangePos	Bit rate for starting the adjustment The recommended value range is [80, 90]. If an excessive bit rate is	None	None	None

Parameter	Description	Application Scenario	H.264	H.265
	unacceptable, set this parameter to **80**. If an excessive bit rate is acceptable, set this parameter to **90**.			
u32MinIprop	Minimum IP ratio	See the parameter description of the CBR	None	None
u32MaxIprop	Maximum IP ratio	See the parameter description of the CBR	None	None
u32MinIQP	Minimum QP of the I frame	See the parameter description of the CBR	None	None

1.3 Description and Usage of AVBR Parameters

AVBR is a type of VBR. The VBR algorithm passively adjusts the bit rate based on the QP value.

- When the encoding pressure is low, the QP value is passively clamped as **MinQp**, the bit rate is decreased and saved.
- When the encoding pressure is high, the QP value is automatically adjusted to ensure that the bit rate does not exceed the maximum bit rate.

AVBR proactively adjusts the bit rate on the basis of VBR.

- When the encoding pressure is low, the target bit rate is proactively decreased to save the bit rate.
- When the encoding pressure is high, the target bit rate is proactively increased and the QP value is adjusted to ensure that the bit rate does not exceed the maximum bit rate.

Table 1-5 AVBR attribute parameters

Parameter	Description	Application Scenario	H.264	H.265
u32Gop	I frame interval Value range: [1, 65536]	This parameter is usually set to an integral multiple of the output frame rate.	Omitted	Same as H.264
u32StatTime	Statistics time Unit: second Value range: [1, 60]	Same as that of the CBR	If this parameter is set to a larger value, the threshold for determining whether to re-encode frames is increased, the number of re-encoding times	Same as H.264

Parameter	Description	Application Scenario	H.264	H.265
			is decreased, but the bit rate fluctuation is increased.	
u32SrcFrmRate	Input frame rate Value range: [1, 240]	Frame rate control	Omitted	Same as H.264
fr32DstFrmRate	Output frame rate Value range: [1/16, 240]	Frame rate control	Omitted	Same as H.264
u32MaxBitRate	Maximum bit rate	Omitted	Omitted	Same as H.264

Table 1-6 Advanced parameters of AVBR (frame-level)

Parameter	Description	Application Scenario	H.264	H.265
s32IPQPDelta	Same as the CBR parameter **s32IPQPDelta**	This parameter is used to adjust the respiratory effect.	Omitted	Omitted
s32ChangePos	Bit rate for starting the adjustment The value range is [80, 90]. If an excessive bit rate is unacceptable, set this parameter to **80**. If an excessive bit rate is acceptable, set this parameter to **90**.	Omitted	Omitted	Omitted
u32MinIprop u32MaxIprop	Minimum/Maximum ratio of I frames to P frames. You are advised not to adjust this parameter.	Same as that of the CBR	Omitted	Omitted
u32MinIQp u32MaxIQp u32MinPQp u32MaxPQp	Minimum and maximum QP values of the I frame and the P frame An appropriate QP value is configured based on the bit rate and scenario. Recommended value: MinQP: [24, 32]	The minimum QP value corresponds to the highest picture quality, and the maximum QP value corresponds to the lowest picture quality. If the maximum QP value is too small, bit rate overshoot occurs when the motion is	The value of **MaxQp** can be fixed at 51. Then the image quality level can be adjusted by configuring **MinQp**.	Same as H.264

Parameter	Description	Application Scenario	H.264	H.265
	MaxQP: [40, 51]	violent.		
s32MinStillPercent	Percentage of the minimum target bit rate in the static scenario Recommended value: [25, 50]	A smaller value indicates more significant decrease of the bit rate in the static scenario. When this parameter is set to 100, the internal bit rate adjustment mechanism will not be started, and the bit rate control effect of the AVBR mode is the same as that of the VBR mode.	Omitted	Omitted
u32MaxStillQP	Maximum QP value of the I frame in the static scenario Recommended value: [30, 40]	If the target bit rate is decreased too significantly, the QP value is increased and the picture quality is lowered in the static scenario. In this case, **u32MaxStillQP** can be used to restrict the maximum QP value of the I frame in the static scenario.	Omitted	Omitted
u32MinStillPSNR	Reserved	Omitted	Omitted	Omitted
s32MaxReEncodeTimes	Maximum number of re-encoding times Value range: [0, 3] Default value: 2 You are advised to enable the re-encoding function because it is effective in ensuring bit rate stability.	Omitted	The default value applies to common scenarios.	Same as H.264

1.4 Description and Usage of Macro Block-level Bit Rate Control Parameters

Table 1-7 Macro block-level bit rate control parameters

Parameter	Description	Application Scenario	H.264	H.265
u32ThrdI[12]	Texture-based macro block-level bit rate control for the I frame Default value for H.264: [5, 5, 5, 10, 10, 10, 255, 255, 255, 255, 255, 255] Default value for H.265: [3, 3, 5, 5, 8, 8, 8, 15, 20, 20, 25, 25] Parameters for the texture-based bit rate control are related to scenarios and are described in documents containing adaptive scenario parameters.	Texture-based bit rate control decreases the QP in the flat regions and increases the QP in the detail regions, allowing for a better subjective image quality.	All the 12 values indicate that the QP is increased and the increment is the texture complexity value of the current macro block minus the threshold. If all values are set to 255, the texture-based macro block-level bit rate control is disabled.	The first four values indicate that the QP is decreased and the decrease is the threshold minus the texture complexity value of the current coding unit (CU). The last eight values indicate that the QP is increased and the increment is the texture complexity value of the current CU minus the threshold.
u32ThrdP[12]	Texture-based macro block-level bit rate control for the P frame Default value for H.264: [5, 5, 5, 255, 255, 255, 255, 255, 255, 255, 255, 255] Default value for H.265: [3, 3, 5, 5, 8, 8, 8, 15, 20, 20, 255, 255] Parameters for the texture-based bit rate control are related to scenarios and are described in documents containing adaptive scenario parameters.	-	All the 12 values indicate that the QP is increased and the increment is the texture complexity value of the current macro block minus the threshold. If all values are set to 255, the texture-based macro block-level bit rate control is disabled.	The first four values indicate that the QP is decreased and the decrease is the threshold minus the texture complexity value of the current CU. The last eight values indicate that the QP is increased and the increment is the texture complexity value of the current CU minus the threshold.

Parameter	Description	Application Scenario	H.264	H.265
u32RowQpDelta	Row-based macro block-level bit rate control Default value: 2 for H.264; 1 or H.265 The row-based bit rate control increases bit rate stability. If **u32RowQpDelta** is set to **0**, the row-based macro block-level bit rate control is disabled.	-	-	-

1.5 Description and Usage of Frame Discarding Parameters in Bit Rate Overshooting Scenarios

Table 1-8 Frame discarding parameters in bit rate overshooting scenarios

Parameter	Description	Application Scenario	Remarks
bFrmLostOpen	Frame discarding switch for the bit rate overshooting scenario	If the bit rate exceeds the threshold, frame discarding is enabled to ensure a stable bit rate.	-
u32FrmLostBpsThr	Bit rate overshooting threshold It is recommended that this threshold is set to the maximum bit rate or 1.2 times of the target bit rate.	-	-
enFrmLostMode	Frame discarding mode Normally discarding frames or encoding frames into Pskip frames.	If bit rate overshooting occurs, frames are discarded or encoded into Pskip frames.	-
u32EncFrmGaps	Number of consecutively discarded frames	This parameter is used to ensure smoothness when frames are consecutively discarded.	If this parameter is set to **0**, frames are consecutively discarded regardless of the frame count.

1.6 Description and Usage of Advanced Parameters for the Jumbo Frame Policy

Table 1-9 Advanced parameters for the jumbo frame policy

Parameter	Description	Application Scenario	Remarks
enSuperFrmMode	Jumbo frame policy	The jumbo frames can be re-encoded, discarded, or normally output.	-
u32SuperIFrmBitsThr	Threshold for the jumbo I frame	Threshold for the number of bits encoded in an I frame	-
u32SuperPFrmBitsThr	Threshold for the jumbo P frame	Threshold for the number of bits encoded in a P frame	-
u32SuperBFrmBitsThr	Threshold for the jumbo B frame	Threshold for the number of bits encoded in a B frame	-

2 Bit Rate Control

2.1 Improving Bit Rate Stability

Table 2-1 lists the methods to improve bit rate stability.

Table 2-1 Methods to improve bit rate stability

Method	Parameter Configuration	Impact
Increase the adjustment amplitude of row-based bit rate control.	Change the default value **2** of VENC_RC_PARAM_S::u32RowQpDelta to **3-5**.	If the value of u32QpDelta is overlarge, the bit rate is stable in still or slow-motion scenarios. However, in fast-motion scenarios, the response to QP adjustment becomes slow and fast-motion bit rate fluctuation grows. Therefore, do not set a value larger than 5.
Set a frame discarding threshold for the bit rate and the number of consecutively discarded frames.	VENC_PARAM_FRAMELOST_S:: bFrmLostOpen = HI_TRUE; VENC_PARAM_FRAMELOST_S:: u32FrmLostBpsThr = frame discarding threshold VENC_PARAM_FRAMELOST_S:: enFrmLostMode = FRMLOST_NORMAL or FRMLOST_PSKIP; VENC_PARAM_FRAMELOST_S:: u32EncFrmGaps = gap for consecutively discarding frames	If the bit rate is out of control, discard frames to decrease the bit rate, which may hinder smooth video display. It is recommended that the frame discarding threshold is 1.1 to 1.2 times of the target bit rate and the gap for consecutively discarding frames is 2 or 3.

2.2 Improving Image Quality

Table 2-2 lists the methods to improve image quality.

Table 2-2 Methods to improve image quality

Method	Parameter Configuration	Impact
Set the image quality level.	VENC_PARAM_H264_CBR_S::s32QualityLevel = 1 VENC_PARAM_H265_CBR_S::s32QualityLevel = 1	When bit rate overshooting occurs, the RC algorithm keeps the bit rate at a relatively low level for a certain period to compensate bit rate overshooting and ensure long-term bit rate stability. If s32QualityLevel is set to a smaller value, the compensation amplitude is reduced, that is, the image quality loss is lowered. However, the compensation time is increased.
Set the maximum QP.	VENC_PARAM_H264_CBR_S::u32MaxQp VENC_PARAM_H265_CBR_S::u32MaxQp	Setting the maximum QP helps effectively protect the image quality, but bit rate overshooting is prone to occur.

2.3 Adjusting the Respiratory Effect

Table 2-3 lists the method to adjust the respiratory effect.

Table 2-3 Method to adjust the respiratory effect

Method	Parameter Configuration	Impact
Set the difference between I and P frames. If the difference is positive, the I frame QP is smaller than the P frame QP.	VENC_PARAM_H264_CBR_S::s32IPQPDelta VENC_PARAM_H265_CBR_S::s32IPQPDelta	The default value of s32IPQPDelta is associated with texture-based bit rate control. If texture-based bit rate control is enabled, the default value of s32IPQPDelta is **6**. If texture-based bit rate control is disabled, the default value of s32IPQPDelta is **2**. To adjust the respiratory effect, the default value of s32IPQPDelta needs to be increased or decreased accordingly.

2.4 Limiting the I Frame Amplitude

Table 2-4 lists the methods to limit the I frame amplitude.

Table 2-4 Methods to limit the I frame amplitude

Method	Parameter Configuration	Impact
Set the maximum IP frame ratio. If the IP frame ratio exceeds the maximum value, an internal algorithm will	VENC_PARAM_H264_CBR_S::u32MaxIprop; VENC_PARAM_H265_CBR_S::u32MaxIprop	In still scenarios, the image quality can be improved by allocating more bits to the I frame. However, if the IP frame ratio is overlarge, the image quality may be decreased.

Method	Parameter Configuration	Impact
limit the I frame size.		
Set the minimum QP of the I frame.	VENC_PARAM_H264_CBR_S::u32MinIQp; VENC_PARAM_H265_CBR_S::u32MinIQp	This method has a strong constraint on the I frame and may cause bit rate insufficiency. Meanwhile, the applicable I frame QP varies depending on scenarios, and the experience value of MinIQp is difficult to obtain.
Set recoding for oversized frames. Usually, set the I frame threshold to the permitted maximum value, and the P frame threshold to a half of the I frame threshold.	VENC_SUPERFRAME_CFG_S::enSuperFrmMode = SUPERFRM_REENCODE; VENC_SUPERFRAME_CFG_S::u32SuperIFrmBitsThr VENC_SUPERFRAME_CFG_S::u32SuperPFrmBitsThr	Too much recoding wastes the chip performance and bandwidth.

2.5 Reducing Motion Smearing and Chrominance Smearing

Motion smearing mainly occurs in the regions where textures are flat. Motion smearing can be reduced by adjusting the parameters of texture-based macroblock-level bit rate control. Chrominance smearing can be reduced by adjusting the chrominance QP offset. Table 2-5 describes the methods of reducing motion smearing and chrominance smearing.

Table 2-5 Methods of reducing motion smearing and chrominance smearing

Method	Parameter Configuration	Side Effect
Adjusting the macroblock-level bit rate control parameters	VENC_RC_PARAM_S::u32ThrdP[12]	Generally, smearing easily occurs in the still regions with simple textures. Smearing can be reduced by decreasing the QP of the regions with simple textures through texture-based bit rate control. However, fewer bits are allocated to the regions with complex textures. As a result, the picture quality is lowered.
Decreasing **chroma_qp_offset**, which reduces chrominance smearing	VENC_PARAM_H264_TRANS_S::chroma_qp_index_offset VENC_PARAM_H265_TRANS_S::cb_qp_offset VENC_PARAM_H265_TRANS_S::cr_qp_offset	The chrominance quality is better if the chrominance QP is decreased. However, fewer bits are allocated to the luminance because more bits are allocated to the chrominance.
Increasing the video	-	Fewer details are retained.

Method	Parameter Configuration	Side Effect
processing subsystem (VPSS) denoising strength		

2.6 Differences Between VBR and AVBR

- Running mechanism of VBR: When the encoding pressure is high in the motion scenario, **StartQp** is adjusted to ensure that the bit rate does not exceed the maximum bit rate. When the encoding pressure is low in the static scenario, **StartQp** is clamped to **MinQp** and the bit rate will be lower than the maximum bit rate, which saves streams.
- Running mechanism of AVBR: The motion detection method is added to encoding. To be specific, the target bit rate is increased in the motion scenario and **StartQp** is controlled to ensure that the bit rate does not exceed the maximum bit rate; the target bit rate is decreased in the static scenario to save streams.
- Differences between VBR and AVBR: The VBR passively saves the bit rate while the AVBR proactively saves the bit rate. In the static scenario, the QP value used by AVBR can be greater than **MinQp**, and therefore bit rate is further saved in the static scenario.

2.7 Low Bit Rate Scenario

- Lower the AE sensitivity of the ISP module to increase the AE response delay and avoid frequent AE adjustment in the case of light/dark shifting.

  Recommended parameter configuration:

  BlackDelayFrame: 8−10. However, the AE adjustment delay is prolonged.

  WhiteDelayFrame: 0−5. However, the AE adjustment delay is prolonged.

  Tolerance: 2−4. However, the AE sensitivity is slightly lowered.
- Increase the VPSS denoising strength and TF/SF strength, and lower the sharpen strength and image detail.

  Recommended parameter configuration: Properly increase the TF/SF strength.
- Set a relatively large GOP and ensure that **u32StatTime** matches the GOP.

  Recommended parameter configuration:

  Set the GOP to 4–10 times of the frame rate. For example, if the frame rate is 30 fps, set the GOP to 120–300. Set **u32StatTime** to 4–10s.
- Properly lower the frame rate or use the Pskip encoding mode to decrease the frame rate.

  Recommended parameter configuration:

  Set the target frame rate to 15 fps.

  VENC_PARAM_FRAMELOST_S:: **enFrmLostMode** = **FRMLOST_PSKIP**

  VENC_PARAM_FRAMELOST_S:: **u32EncFrmGaps** = **2**
- Enable texture-based macroblock-level bit rate control and set the recommended parameters.

2.8 Notes

Note the following issues:

- **u32Gop**: You are advised to set **u32Gop** to an integral multiple of the encoding frame rate. If not, I frame distribution may be uneven in terms of time, causing transient bit rate fluctuation. For a medium and high bit rate, the GOP can be equal to the encoding frame rate. For a low bit rate, the GOP needs to be increased.
- **u32StatTime**: **u32StatTime** is set to an integral multiple of the GOP or encoding frame rate. For example, if the frame rate is 25 fps and the GOP is 50, **u32StatTime** should be set to 2s or 4s. Inconsistency between **u32StatTime** and GOP may cause transient bit rate instability and image quality instability. In common scenarios, **u32StatTime** can be set to a double of the GOP. If long-term bit rate stability is concerned, and short-term fluctuation is not, **u32StatTime** can be set to a larger value, for DVR storage, for example.
- **u32SrcFrmRate**: **u32SrcFrmRate** is set to the VI frame rate. The internal frame rate control of the encoder may verify the timestamp to determine whether frame loss occurs. The timestamp is added during VI image capturing. Therefore, **u32SrcFrmRate** must be consistent with the actual VI frame rate. If not, the actual frame rate is inconsistent with the target frame rate.
- **u32MaxIprop**: **u32MaxIprop** is used to limit the I frame that is larger than the P frame by **u32MaxIprop** times, helping effectively limit the I frame size in still scenarios.
- **u32MaxQp**: **u32MaxQp** is used to limit the maximum QP. The recommended value is 51 if the bit rate rather than quality is concerned. The recommended value range is [40, 51] if quality rather than bit rate overshooting is concerned.
- **u32MinQp/u32MinIQp**: **u32MinQp/u32MinIQp** is used to limit the minimum QP. If bit rate reduction is required in still or slow-motion scenarios. The recommended value range is [10, 20] for the CBR mode and [24, 32] for the VBR mode.
- For oversized frame discarding, the current encoded frame is discarded. For frame discarding in the case of bit rate overshooting, the next frame is discarded. The two methods do not conflict and can work together.
- ROI and OSD protection may affect the bit rate control. If large areas of ROI and OSD protection with low QP values are configured in low bit rate scenarios, the entire quality of the picture may deteriorate, and bit rate overshooting may be caused.