CV180X & CV181X BitRate Control User Guide

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Contents

Revision History

Revision	Date	Description
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Contact Us

Address Building 1, Yard 9, FengHao East Road, Haidian District, Beijing, 100094, China

Building T10, UpperCoast Park, Huizhanwan, Zhancheng Community, Fuhai Street, Baoan District, Shenzhen, 518100, China

Phone +86-10-57590723 +86-10-57590724

Website https://www.sophgo.com/

Forum https://developer.sophgo.com/forum/index.html

2 Meaning and Usage of Bitrate Control Parameters

2.1 CBR Parameter Description and Usage

The description of CBR parameters is shown in the table below.

Parameter	Description	Suggestions
u32Gop	I-Frame interval	Recommended to set to an integral-multiple of the frame rate
u32StatTime	Bit rate statistics time length (unit: seconds)	Recommended to set as an integral-multiple of Gop or frame rate. A smaller statistical time length makes the short-term bit rate fluctuation smaller. while a larger statistical time length makes the short-term rate fluctuation larger and the image quality better.
u32BitRate	Target bitrate	According to the actual scene settings, the higher the target bit rate, the better the image quality, and the higher the bandwidth required.
u32MaxQp	Maximum Qp	This limits the maximum Qp of macroblock, and also limits the worst image quality. If the bit rate is set too low, it may lead to a greater chance of bit rate overshoot. Recommended value: [40, 51]
u32MinQp	Minimun Qp	This limits the minimum Qp of macroblock, and also limits the best image quality. It will save bit rate when the quality is good enough. An overhigh setting may result in insufficient bit rate. Recommended value: [12, 20]
u32MaxIQp	Maximum I-Frame Qp	Limit the maximum Qp of I-Frame macroblock. For the still scene, it is recommended to set a smaller maximum Qp to make the quality of the still part of the image better. Recommended value: [36, 44]
u32MinIQp	Minimum I-Frame Qp	Limit the minimum Qp of I-Frame macroblock. Save the bit rate when the quality is good enough. Recommended value: [16, 24]

2.2 VBR Parameter Description and Usage

The description of VBR parameters is shown in the table below.

Parameter	Description	Suggestions
u32Gop	I-Frame interval	Recommended to set it to an integral-multiple of the frame rate
u32StatTime	Bit rate statistics time length (unit: seconds)	Recommended to set it as an integral-multiple of (Gop / frame rate). A smaller statistical time makes the short-term rate fluctuation smaller. while a larger statistical time length makes the short-term rate fluctuation larger and the image quality better.
u32MaxBitRate	Maximum Bitrate	Set according to the application scenario. The larger the maximum bit rate, the better the image quality and the higher the required bandwidth.
s32ChangePos	Rate adjustment threshold	It is suggested to adjust the interval between [75, 90]. If more attention is paid to the bit rate exceeding, it is suggested to set to 75. Otherwise, set the threshold to 90 when the bit rate exceeding has little effect.
u32MaxQp	Maximum Qp	To limit the maximum Qp of macroblock. Is to limit the worst image quality. If the bit rate is set too low, it may lead to a greater chance of bit rate overshoot. Recommended value: [40, 51]
u32MinQp	Minimum Qp	To limit the minimum Qp of macroblock, is to limit the best image quality, and reduce the bit rate when the quality is good enough. An overhigh setting may result in insufficient bit rate. Recommended value: [12, 20]
u32MaxIQp	Maximum I-Frame Qp	Limit the maximum Qp of I-Frame macroblock. For the still scene, it is recommended to set a smaller maximum Qp to make the quality of the still part of the image better. Recommended value: [36, 44]
u32MinIQp	Minimum I-Frame Qp	Limit the minimum Qp of I-Frame macroblock. Reduce the bit rate when the quality is good enough. Recommended value: [16, 24]

2.3 AVBR Parameter Description and Usage

The description of AVBR parameters is shown in the table below.

Parameter	Description	Suggestions
u32Gop	I-Frame interval	Recommended to set it to an integral multiple of the frame rate
u32StatTime	Bit rate statistics time length (unit: seconds)	Suggested to set it as an integral multiple of (Gop / frame rate). A smaller statistical time makes the short-term rate fluctuation smaller. while a larger statistical time length makes the short-term rate fluctuation larger and the image quality better.
u32MaxBitRate	Maximum Bitrate	Set according to the application scenario. The larger the maximum bit rate, the better the image quality and the higher the required bandwidth.
s32ChangePos	Rate adjustment threshold	It is suggested to adjust the interval between [75, 90]. If more attention is paid to the bit rate exceeding, it is suggested to set to 75. Otherwise, set the threshold to 90 when the bit rate exceeding has little effect.
u32MaxQp	Maximum Qp	Limit the maximum Qp of macroblock. That is, limit the worst image quality. If the bit rate is set too low, it may lead to a greater chance of bit rate overshoot. Recommended value: [40, 51]
u32MinQp	Minimum Qp	Limit the minimum Qp of macroblock. That is, limit the best image quality, and save the bit rate when the quality is good enough. An overhigh setting may result in insufficient bit rate. Recommended value: [12, 20]
u32MaxIQp	Maximum I-Frame Qp	Limit the maximum Qp of I-Frame macroblock. For the still scene, it is recommended to set a smaller maximum Qp to make the quality of the still part of the image better. Recommended value: [36, 44]
u32MinIQp	Minimum I-Frame Qp	Limit the minimum Qp of I-Frame macroblock. Reduce the bit rate when the quality is good enough. Recommended value: [16, 24]
s32MinStillPercent	Static scene bitrate percentage	The minimum bit rate of still scenes is the maximum bit rate multiplied by the percentage set. The smaller the setting, the more significant the bit rate drop in still scenes. Recommended value: [10, 50]
u32MaxStillQp	Max Qp for Still Picture	The smaller the setting, the better the image quality can be guaranteed for still scenes and minor movements. Recommended value:[32, 40]
u32MotionSensitivity	Motion sensitivity	The degree of scene motion corresponds to the sensitivity setting of bit rate adjustment.

2.4 Macroblock-level Rate Control Parameter Description and Usage

The description of macroblock level rate control parameters is shown in the table below.

Parameter	Description	Suggestions
u32RowQpDelta	Macroblock-level Rate Control Qp Delta Parameter	If the setting is greater than 0, it means that the macroblock-level rate control is used to control the code rate stability. The Qp delta of the row is not being adjusted significantly at the moment. Recommended value: 1
s32FirstFrameStartQp	Initial Qp for the First Frame	Set an appropriate start Qp based on the target bit rate resolution scenario. Recommended value: 36. The values are as follows: H.264: 1~51 H.265: 1~51, 63(Internal Decision)
u32ThrdLv	Texture Macroblock-level Rate Auto-control Parameter	The system ADAPTS the threshold level of texture-level bitrate control. It is used to control the Qp distribution range of intra-frame encoding. The smaller the value, the smaller the difference between max Qp and min Qp of intra-frame encoding, which can be used to adjust respiration effect and drag problem. Default value: 2. The value ranges from 0 to 4

2.5 Frame Dropping Parameter and Usage Instructions for High Bitrate Encoding

Frame dropping parameters for high bitrate encoding are shown in the table below.

Parameter	Description	Suggestions
bFrmLostOpen	Rate Overshoot Frame Dropping Switch	When the bit rate exceeds the threshold, frame loss is enabled to ensure that the peak of the interval bit rate is not too high.
u32FrmLostBpsThr	Rate Overshoot Frame Dropping Threshold	Set according to the system capacity. It is recommended to set to at least 1.2 times the code rate.
enFrmLostMode	Frame Dropping Mode Selection	Only PSkip frame loss mode is supported.
u32EncFrmGaps	Maximum Consecutive Frame Dropping Count	Limiting the maximum number of consecutive frame loss can make the picture smoother during frame loss period, and the interval of rate spike may be higher. Value set to 0 means that the number of consecutive frames is not limited.

3 Meaning and Usage of GOP Structure Parameters

3.1 Instruction and Usage of Single-Reference P-Frame GOP Structure Properties

The parameters of single-reference P-frame encoding GOP structure are shown in the following table.

Parameter	Description	Instructions
s32IPQpDelta	I-P delta QP	Adjusting I-frame quality and size, with positive values indicating that the I-frame QP is lower than the P-frame QP. By setting an appropriate delta value, the breathing effect can be reduced. Recommended value: [2,6]

3.2 Instruction and Usage of Intelligent P-frame GOP structure properties

The parameters of intelligent P-frame encoding GOP structure are shown in the following table.

Parameter	Description	Instructions
u32BgInterval	Long-term Reference Frame Interval	Required to be set as an integral multiple of GOP. Recommended to be 10-12 times the frame rate.
s32BgQpDelta	Long-term Reference Frame Delta Quantization Parameter	It needs to be set as an integer multiple of the GOP, and it is recommended to be 10-12 times the frame rate. Recommended value: [4,6]

4 Bitrate Control Topic

4.1 Bit rate stability

- When the bit rate exceeds the threshold, frame loss can reduce the instantaneous rate fluctuation and maintain the image quality.
- Recommended settings:

```
VENC_FRAMELOST_S::bFrmLostOpen = TRUE
VENC_FRAMELOST_S::u32FrmLostBpsThr = u32BitRate * 1.2
VENC_FRAMELOST_S::enFrmLostMode = FRMLOST_PSKIP
VENC_FRAMELOST_S::u32EncFrmGaps = 1
```

4.2 Improvement of image quality

- u32MaxIQp, u32MaxQp are parameters that limit the maximum QP of macroblock. Lower value of the setting can ensure better image quality under low bit rate encoding or drastical scene changes. Meanwhile, it is easy to cause bit rate overshoot. It is recommended to adjust the appropriate maximum QP according to the application requirements

4.3 Control of breath-effect

- s32IPQPDelta is the QP difference between IP frames. Setting a larger difference can reduce the breath-effect. When the scene is still, it is recommended to set a larger difference.
- Recommended value of still scene: [2,6];
- Recommended value of dynamic scene: [2,4]
- Lower s32IPQPDelta slightly when the noise is loud in low-light scenes. Reducing I-frame rate and increasing P-frame rate can avoid breathing effect caused by excessive noise induced by high quality I-frame.

4.4 Limiting I-frame amplitude

- Setting the I-frame minimum QP has the opportunity to reduce the I-frame bit rate, but has the risk of decreasing picture quality. But it is not easy to control. It requires operating experience in scenes to have better setting.Overhigh bit rate may still occur.

4.5 Reduction in motion streaks

- Through texture-level rate control, one can effectively reduce the obvious streak of flat area. One can adjust the texture macroblock-level rate control parameters appropriately to reduce the steak of flat area and increase the details. Meanwhile, increasing the QP of the complex texture area may also make the area more distorted. It is suggested to adjust according to the balance between the target bit rate and scene.

4.6 Reduction in chroma shift

- cb_qp_offset, cr_qp_offset are the parameters for chroma quality adjustments. Reducing the chroma QP can improve the quality of chroma image and reduce the color deviation of the image. Meanwhile, the brightness of the image may be reduced. It is suggested to adjust according to the balance between the target bit rate and scene.

4.7 Initial QP of bitrate control

- An appropriate initial QP should be set by considering the scene, bit rate, resolution, and etc. Users can configure the appropriate initial QP value through VENC_RC_PARAM_S::s32FirstFrameStartQp. The interface is valid between creating the channel and encoding the first frame.

4.8 Low bit rate scenarios

- Turn on texture-level macro block rate control. It is recommended to use default parameters or fine tune them appropriately. For example, in the outdoor scenario, set u32ThrdLv to value 3.
- Reduce the frame rate according to the scene. For example, set the target frame rate to 20fps.
- Configure to encode PSkip to dynamically reduce the frame rate VENC_FRAMELOST_S::enFrmLostMode = FRMLOST_PSKIP; VENC_FRAMELOST_S::u32EncFrmGaps = 1

- Use a larger GOP. The rate statistical duration, u32StatTime, is recommended to match the GOP. GOP is recommended to set at 5-10 times the frame rate. For example, when frame rate is equal to 30fps, GOP is set to 150-300 and u32StatTime is set to 5-10 seconds.
- It is recommended to use SmartP mode coding for still scenes such as fixed cameras. When using SmartP mode, u32BgInterval should match u32StatTime.
- Reducing the sensitivity of AE in ISP module and increasing the reaction delay of AE can avoid the frequent adjustment of AE after the change of light intensity.
- Increase the intensity of 3DNR denoising and reduce the intensity of Sharpeness appropriately to reduce the image details.

4.9 Precautions

- U32Gop：Suggested to set it as an integral multiple of the coding frame rate. If not set as an integral multiple, the instantaneous bit rate will fluctuate due to the uneven distribution of I frame in time
- u32StatTime：Recommended to set it to an integral multiple of (Gop / fps). For example, when frame rate is 30fps and GOP is 60, the statistical duration should be set to an integral multiple of 2 seconds.
- u32MaxIQp, u32MaxQp：Limit the maximum QP within the frame. It is recommended to set to [40, 46]. When focusing on quality, it is easier to cause rate overshoot.
- u32MinQp、u32MinIQp：Limit the minimum QP in frame. Appropriate settings can save the bit rate when the image is still or in s motion.
- The ROI setting Qp can affect the stability of the code rate control if it is too low. The ROI should be set appropriately for the target bitrate.
- OSD images are usually sharp-edged fonts, and an overly large OSD area may increase encoding pressure.