Smart Coding User Guide

Version: 1.4.0

Release date: 2022-11-10

Contents

Revision History

Revision	Date	Description
0.1	2021/05/24	Start from CV1835 Intelligent Coding Usage Guide_v0.3.0.1
1.1.1	2021/06/09	Start from CV182x Intelligent Coding Usage Guide _v0.1
1.2.0	2021/09/22	Start from CV182x Intelligent Coding Usage Guide _v1.1.1
1.3.0	2022/06/13	Start from CR182x Intelligent Coding Usage Guide _v1.2.0
1.4.0	2022/11/10	Start from CR182x Intelligent Coding Usage Guide _v1.3.0

1 Disclaimer

Terms and Conditions

The document and all information contained herein remain the CVITEK Co., Ltd' s ("CVITEK") confidential information, and should not disclose to any third party or use it in any way without CVITEK' s prior written consent. User shall be liable for any damage and loss caused by unauthority use and disclosure.

CVITEK reserves the right to make changes to information contained in this document at any time and without notice.

All information contained herein is provided in "AS IS" basis, without warranties of any kind, expressed or implied, including without limitation mercantability, non-infringement and fitness for a particular purpose. In no event shall CVITEK be liable for any third party' s software provided herein, User shall only seek remedy against such third party. CVITEK especially claims that CVITEK shall have no liable for CVITEK' s work result based on Customer' s specification or published shandard.

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 GOP Structure and Applicable Scenarios

2.1 GOP Mode List

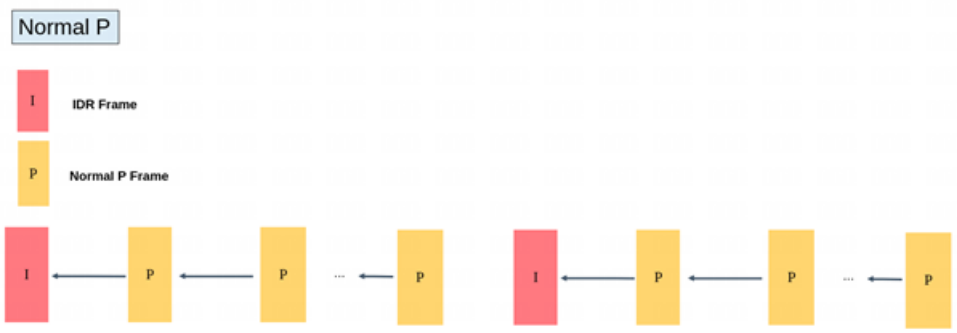
Mode	Description
NormalP	The P frame only refers to the previous reference frame
SmartP	The P frame only refers to the previous reference frame, and the VI frame refers to the previous IDR frame

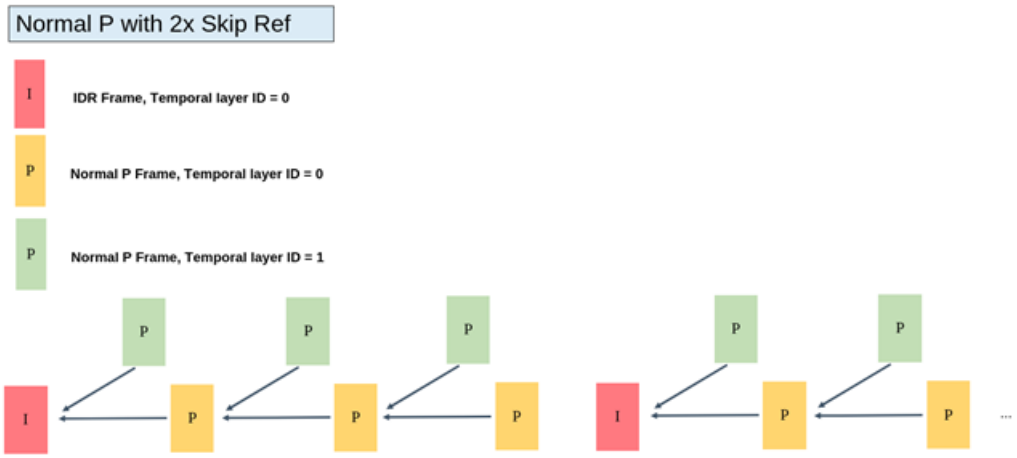
2.2 Description and Usage of NormalP mode GOP structure

2.2.1 Description of NormalP mode GOP structure

- NormalP is the most common GOP structure, which only has forward reference to the previous frame, and is also known as IPPP coding.
- In case of no special requirements, it is recommended to use NormalP mode.

The GOP structure of NormalP mode is shown in the following figure.





2.2.2 Usage of NormalP mode GOP structure

- Related interface

`CVI_MPI_VENC_CreateChn`

- Related parameters

```
VENC_CHN_ATTR_S::stGopAttr.enGopMode = VENC_GOPMODE_NORMALP
VENC_CHN_ATTR_S::stRcAttr.u32Gop = 60;
VENC_CHN_ATTR_S::stGopAttr.stNormalP.s32IPQpDelta is recommended to set to 3.
The larger the value, the higher the bitrate of the I-frame and the better the␣
↪image quality.
```

2.3 Description and Usage of SmartP mode GOP structure

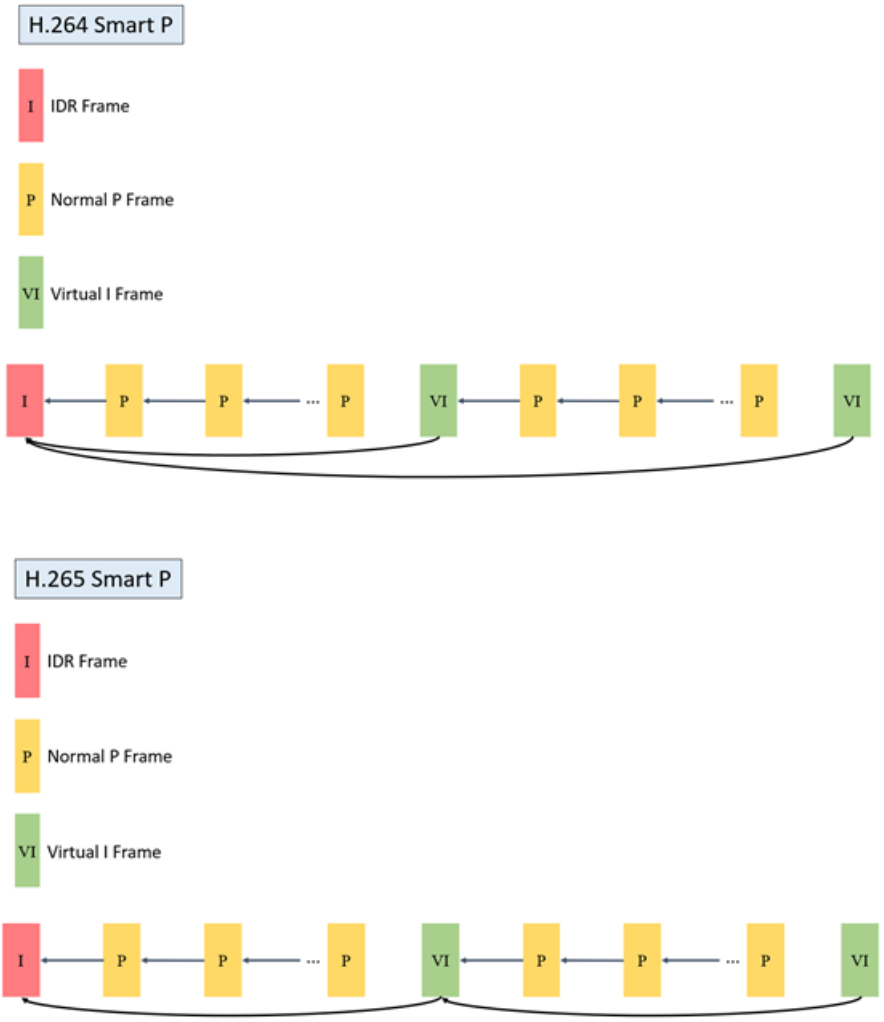
2.3.1 Description of SmartP mode GOP structure

• The SmartP mode includes two types of P-frames: normal P-frames and virtual-I frames. The virtual-I frames use a long-term reference frame to refer to the previous IDR frame

• SmartP is mainly used in monitoring scenarios. Due to the fixed camera installation, the scene is mostly static background, and only people and objects move. Use virtual-I instead of I-frame to lengthen the IDR frame encoding period, thereby reducing the bit rate and reducing the breath-effect.

• Limited coding efficiency improvement for camera moving scenes due to no fixed background

The SmartP mode GOP structures are shown in the following figures.



2.3.2 Usage of SmartP mode GOP structure

- Related interface

`CVI_VENC_CreateChn`

- Related parameters

```
VENC_CHN_ATTR_S::stGopAttr.enGopMode = VENC_GOPMODE_SMARTP
VENC_CHN_ATTR_S::stGopAttr.stSmartP.u32BgInterval = 300;  //  10secs for fps=30
VENC_CHN_ATTR_S::stRcAttr.u32Gop = 60; // virtual I interval, 2 secs for fps=30
VENC_CHN_ATTR_S::stRcAttr.u32StatTime = 10 // secs
VENC_CHN_ATTR_S:: stGopAttr.stSmartP.s32BgQpDelta = 4
```

2.4 Memory usage, latency, application scenarios and compatibility of GOP Structure

Mode	DDR usage	Latency	Applicable Scenarios
	H.264 / H.265 Enc	H.264 / H.265 Enc	
NormalP	2*PicSize	N/A	General Scenarios
SmartP	2*PicSize	N/A	Monitoring Scenarios

Caculation of PicSize

- The calculation method for the size of each variable block (VB) in the encoded frame memory (reference frame and reconstructed frame) is as follows:
  - H.264
    - PicSize= FrameBufSize
  - H.265
    - PicSize= FrameBufSize + mvColSize + fbcYTblSize + fbcCTblSize + subSampledSize
  - Please refer to the chapter "video coding" in the document 《cv180x media software development reference》 for the calculation of each sub item of frame memory size

Compatibility

The compatibility of Cvitek backend products is shown in the following table

	CV180x	
	H.264	H.265
NormalP	Yes	Yes
SmartP	Yes	Yes

3 Encoder Input Message

3.1 ROI Interface Definition

ROI（Region Of Interest）coding：Region Of Interest coding

Users can adjust the image Qp of this region by configuring ROI region, so as to realize the differentiation of image quality in local regions.

Both H.264 and H.265 support 8 ROI settings, and the priority of repeated region increases according to the ROI index number from 0 to 7.

The ROI region can be configured with two modes: absolute Qp mode and relative Qp mode.

Absolute QP mode: the QP in the ROI area is the QP value set by the user.

Relative QP mode: the QP of ROI area is the QP of rate control plus the QP offset value set by the user.

Precaution

ROI area can be configured only when the code rate control mode is not fixed Qp mode.

When ROI starts to work in H.264, macroblock level rate control cannot work.

In absolute QP mode, because the rate control adapts the macroblock QP, there may be some differences between the actual coded QP and the configured QP.

3.1.1 CVI_VENC_SetRoiAttr

【Description】

Set the ROI properties for the H.264/H.265 channel.

【Syntax】

```
CVI_S32 CVI_VENC_SetRoiAttr(VENC_CHN VeChn, const VENC_ROI_ATTR_S␣
↪*pstRoiAttr);
```

【Parameter】

Name	Descriotion	Input/Output
VeChn	VENC Channel number	Input
pstRoiAttr	ROI region parameter	Input

【Return Value】

Return Value	Description
CVI_SUCCESS	Success
Non 0	Failure, please refer to the error code.

【Requirement】

- Header files: cvi_comm_venc.h、cvi_venc.h
- Library files: libvenc.a

【Note】

- u32Index：Each channel can be set with 8 ROI regions. The ROI zones are managed by indexes ranging from 0 to 7. u32Index indicates the ROI index set by the user. Repeat areas are prioritized in order of ROI index numbers from 0 to 7.
- bEnable：Specifies whether the current ROI area is enabled.
- bAbsQp：Specifies whether absolute QP or relative QP mode is used for the current ROI region.
- s32Qp：When bAbsQp is CVI_TRUE, s32Qp is the Qp value set for the ROI area. When bAbsQp is CVI_FALSE, s32Qp is the Qp value from the internal rate control of the ROI area plus the Qp offset value.
- stRect：Specify the location coordinates and size of the current ROI area. The ROI area must be within the image range.
- The system has no ROI area enabled by default. The user must set and call this interface to start ROI after the coding channel is created and before the coding channel is destroyed. When this interface is called during encoding, it takes effect on the next frame.
- It is recommended that users call this interface before starting the encoding after creating the channel to reduce the number of calls during encoding.
- It is recommended that users call the CVI_VENC_GetRoiAttr interface before calling this interface to obtain the ROI configuration of the current channel and then set it.
- After setting the interface, if the current frame is judged to be PSkip frame, the PSkip frame effect takes precedence.
- The ROI area can be configured only when the bitrate control mode is not fixed QP mode.
- When ROI starts to work in H.264, macroblock level rate control cannot work.
- Because the internal rate control adapts the macro block QP, the actual coding QP may be different from the QP set by the absolute Qp mode.

【Example】

- None

3.1.2 CVI_VENC_GetRoiAttr

【Description】

Get the ROI properties of H.264/H.265 channels.

【Syntax】

```
CVI_S32 CVI_VENC_GetRoiAttr(VENC_CHN VeChn, CVI_U32 u32Index, VENC_
↪ROI_ATTR_S *pstRoiAttr);
```

【Parameter】

Name	Description	Input/Output
VeChn	VENC Channel number	Input
u32Index	Index number of ROI area	Input
pstRoiAttr	ROI regional parameter	Input

【Return Value】

Return Value	Description
CVI_SUCCESS	Success
Non 0	Failure, please refer to the error code.

【Requirement】

- Header files: cvi_comm_venc.h、cvi_venc.h
- Library files: libvenc.a

【Note】

- Obtain the ROI region configuration according to u32index index
- The user must set and call this interface after the encoding channel is created and before the channel is destroyed
- It is recommended that users call CVI_VENC_SetRoiAttr interface to obtain the ROI configuration of the current channel then set it.

【Example】

- None

3.2 Bitrate Control Interface

```
typedef enum _VENC_RC_MODE_E {

    VENC_RC_MODE_H264CBR = 1,
    VENC_RC_MODE_H264VBR,
    VENC_RC_MODE_H264AVBR,
    VENC_RC_MODE_H264QVBR,
    VENC_RC_MODE_H264FIXQP,
    VENC_RC_MODE_H264QPMAP,

    VENC_RC_MODE_MJPEGCBR,
    VENC_RC_MODE_MJPEGVBR,
    VENC_RC_MODE_MJPEGFIXQP,

    VENC_RC_MODE_H265CBR,
    VENC_RC_MODE_H265VBR,
    VENC_RC_MODE_H265AVBR,
    VENC_RC_MODE_H265QVBR,
    VENC_RC_MODE_H265FIXQP,
    VENC_RC_MODE_H265QPMAP,

    VENC_RC_MODE_BUTT,
} VENC_RC_MODE_E;

typedef struct _VENC_RC_ATTR_S {
  VENC_RC_MODE_E enRcMode; /* RW; the type of rc*/
  union {

      VENC_H264_CBR_S stH264Cbr;
      VENC_H264_VBR_S stH264Vbr;
      VENC_H264_AVBR_S stH264AVbr;
      VENC_H264_QVBR_S stH264QVbr;
      VENC_H264_FIXQP_S stH264FixQp;
      VENC_H264_QPMAP_S stH264QpMap;

      VENC_MJPEG_CBR_S stMjpegCbr;
      VENC_MJPEG_VBR_S stMjpegVbr;
      VENC_MJPEG_FIXQP_S stMjpegFixQp;

      VENC_H265_CBR_S stH265Cbr;
      VENC_H265_VBR_S stH265Vbr;
      VENC_H265_AVBR_S stH265AVbr;
      VENC_H265_QVBR_S stH265QVbr;
      VENC_H265_FIXQP_S stH265FixQp;  ///< The Attribute of FixedQp Mode
      VENC_H265_QPMAP_S stH265QpMap;

  };
} VENC_RC_ATTR_S;
```

4 Encoder Output Message

4.1 MeanQp

Parameter	Description
u32MeanQp	The average Qp for the entire frame