

# **Application Programming Interface (API) for RK Hardware Codec**

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## 1. Codecs Supported by RK

Only H264 and VP8 are supported.

## 2. Head file and Library Files

The head file we need:

- vpu\_api.h

The library files we need:

- librk\_vpuapi.so
- libvpu.so

## 3. Structure

### 3.1 Defining the Codec Enumeration Type

**The enumeration type of the image inputted when encoding:**

```
typedef enum
{
    VPU_H264ENC_YUV420_PLANAR = 0, /* YYYY... UUUU... VVVV */
    VPU_H264ENC_YUV420_SEMIPLANAR = 1, /* YYYY... UVUVUV... */
    VPU_H264ENC_YUV422_INTERLEAVED_YUYV = 2, /* YUYVYUYV... */
    VPU_H264ENC_YUV422_INTERLEAVED_UYVY = 3, /* UYVYUYVY... */
    VPU_H264ENC_RGB565 = 4, /* 16-bit RGB */
    VPU_H264ENC_BGR565 = 5, /* 16-bit RGB */
    VPU_H264ENC_RGB555 = 6, /* 15-bit RGB */
    VPU_H264ENC_BGR555 = 7, /* 15-bit RGB */
    VPU_H264ENC_RGB444 = 8, /* 12-bit RGB */
    VPU_H264ENC_BGR444 = 9, /* 12-bit RGB */
    VPU_H264ENC_RGB888 = 10, /* 24-bit RGB */
    VPU_H264ENC_BGR888 = 11, /* 24-bit RGB */
    VPU_H264ENC_RGB101010 = 12, /* 30-bit RGB */
    VPU_H264ENC_BGR101010 = 13 /* 30-bit RGB */
} H264EncPictureType;
```

**The enumeration type of the codec type structure:**

```
typedef enum OMX_RK_VIDEO_CODINGTYPE
{
    OMX_RK_VIDEO_CodingUnused, /**< Value when coding is N/A */
    OMX_RK_VIDEO_CodingAutoDetect, /**< Autodetection of coding type */
    OMX_RK_VIDEO_CodingMPEG2, /**< AKA: H.262 */
    OMX_RK_VIDEO_CodingH263, /**< H.263 */
    OMX_RK_VIDEO_CodingMPEG4, /**< MPEG-4 */
    OMX_RK_VIDEO_CodingWMV, /**< Windows Media Video (WMV1,WMV2,WMV3)*/
}
```

```

OMX_RK_VIDEO_CodingRV,    /**< all versions of Real Video */
OMX_RK_VIDEO_CodingAVC,   /**< H.264/AVC */
OMX_RK_VIDEO_CodingMJPEG, /**< Motion JPEG */
OMX_RK_VIDEO_CodingVP8,   /**< VP8 */
OMX_RK_VIDEO_CodingVP9,   /**< VP9 */
OMX_RK_VIDEO_CodingVC1=0x01000000,
/**<WindowsMediaVideo(WMV1,WMV2,WMV3)*/
OMX_RK_VIDEO_CodingFLV1,   /**< Sorenson H.263 */
OMX_RK_VIDEO_CodingDIVX3,   /**< DIVX3 */
OMX_RK_VIDEO_CodingVP6,
OMX_RK_VIDEO_CodingHEVC,   /**< H.265/HEVC */
OMX_RK_VIDEO_CodingKhronosExtensions = 0x6F000000,
/**< Reserved region for introducing Khronos Standard Extensions */
OMX_RK_VIDEO_CodingVendorStartUnused = 0x7F000000,
/**< Reserved region for introducing Vendor Extensions */
OMX_RK_VIDEO_CodingMax = 0x7FFFFFFF
} OMX_RK_VIDEO_CODINGTYPE;

```

**The enumeration type of the codec category structure:**

```

typedef enum CODEC_TYPE
{
CODEC_NONE,
CODEC_DECODER,/*Decoding*/
CODEC_ENCODER,/*Encoding*/
CODEC_BUTT,
} CODEC_TYPE;

```

**The enumeration type of the value type for the returned error message:**

```

typedef enum VPU_API_ERR
{
VPU_API_OK = 0,
VPU_API_ERR_UNKNOW = -1,
VPU_API_ERR_BASE = -1000,
VPU_API_ERR_LIST_STREAM    = VPU_API_ERR_BASE - 1,
VPU_API_ERR_INIT          = VPU_API_ERR_BASE - 2,
VPU_API_ERR_VPU_CODEC_INIT = VPU_API_ERR_BASE - 3,
VPU_API_ERR_STREAM        = VPU_API_ERR_BASE - 4,
VPU_API_ERR_FATAL_THREAD  = VPU_API_ERR_BASE - 5,
VPU_API_ERR_EOS_STREAM_REACHED = VPU_API_ERR_BASE - 11,
VPU_API_ERR_BUTT,
} VPU_API_ERR;

```

## 3.2 Defining the Codec Structure

### The structure of the video packet:

```
typedef struct VideoPacket
{
    RK_S64 pts;          /* with unit of us*/
    RK_S64 dts;          /* with unit of us*/
    RK_U8 *data;         /* start address of stream data per frame*/
    RK_S32 size;         /* length of the stream per frame*/
    RK_U32 capability; /* NOTE: 0->no packet loss 1 packet loss*/
    RK_U32 nFlags;
} VideoPacket_t;
```

### The structure of the image outputted after decoding:

```
typedef struct DecoderOut
{
    RK_U8 *data;         /*image data after decoding*/
    RK_U32 size;         /*image size after decoding*/
    RK_S64 timeUs;
    RK_S32 nFlags;
} DecoderOut_t;
```

### The structure of the image inputted before encoding:

```
typedef struct EncInputStream
{
    RK_U8 *buf;         /* image data after encoding */
    RK_S32 size;       /* image size after encoding */
    RK_U32 bufPhyAddr; /*image's physical address after encoding*/
    RK_S64 timeUs;
    RK_U32 nFlags;
} EncInputStream_t;
```

### The structure of the bit stream outputted after encoding:

```
typedef struct EncoderOut
{
    RK_U8 *data; /*stream data per frame */
    RK_S32 size; /*stream data per frame*/
    RK_S64 timeUs;
    RK_S32 keyFrame; /*key frame*/
} EncoderOut_t;
```

**The structure of the encoding parameters:**

```
typedef struct EncParameter
{
    int width;
    int height;
    int rc_mode;
    int bitRate;
    int framerate;
    int qp;
    int enableCabac;
    int cabacInitIdc;
    int format;
    int intraPicRate;
    int framerateout;
    int profileIdc;
    int levelIdc;
    int reserved[3];
} EncParameter_t;
```

**The structure of the encoding parameters (no need to configure and set):**

```
typedef struct
{
    int width;
    int height;
    int rc_mode;
    int bitRate;
    int framerate;
    int qp;
    int reserved[10];
} EncParams1;
```

**The structure of the extra codec parameters (no need to configure and set):**

```
typedef struct EXtraCfg {
    RK_S32 vc1extra_size;
    RK_S32 vp6codeid;
    RK_S32 tsformat;
    RK_U32 reserved[20];
} EXtraCfg_t;
```

**The context structure of VPU codec:**

```
typedef struct VpuCodecContext
{
    void* vpuApiObj;
    CODEC_TYPE codecType;
    OMX_RK_VIDEO_CODINGTYPE videoCoding;
```

```

RK_U32 width;
RK_U32 height;
RK_U8 *extradata;
RK_S32 extradata_size;
RK_U8 enableparsing;
RK_S32 no_thread;
EXtraCfg_t extra_cfg;
void* private_data;
/*
** 1: error state(not working) 0: working
*/
RK_S32 decoder_err;
/**
* Allocate and initialize an VpuCodecContext.
*
* @param ctx The context of vpu api, allocated in this function.
* @param extraData The extra data of codec, some codecs need / can
* use extradata like Huffman tables, also live VC1 codec can
* use extradata to initialize itself.
* @param extra_size The size of extra data.
*
* @return 0 for init success, others for failure.
* note: check whether ctx has been allocated success after you do init.
*/
RK_S32 (*init)(struct VpuCodecContext *ctx, RK_U8 *extraData, RK_U32 extra_size);
/**
* @return 0 for decode success, others for failure.
*/
RK_S32 (*decode)(struct VpuCodecContext *ctx, VideoPacket_t *pkt, DecoderOut_t *aDecOut);
/**
* @return 0 for encode success, others for failure.
*/
RK_S32 (*encode)(struct VpuCodecContext *ctx, EncInputStream_t *aEncInStrm,
EncoderOut_t *aEncOut);
/**
* flush codec while do fast forward playing.
*
* @return 0 for flush success, others for failure.
*/
RK_S32 (*flush)(struct VpuCodecContext *ctx);
RK_S32 (*control)(struct VpuCodecContext *ctx, VPU_API_CMD cmdType, void* param);
/**
*seperate the decode function to two function

```

```

*
*/
RK_S32 (*decode_sendstream)(struct VpuCodecContext *ctx, VideoPacket_t *pkt);
RK_S32 (*decode_getframe)(struct VpuCodecContext *ctx, DecoderOut_t *aDecOut);
RK_S32 (*encoder_sendframe)(struct VpuCodecContext *ctx, EncInputStream_t *aEncInStrm);
RK_S32 (*encoder_getstream)(struct VpuCodecContext *ctx, EncoderOut_t *aEncOut);
} VpuCodecContext_t;
/* allocated vpu codec context */
#ifdef __cplusplus
extern "C"
{
#endif
RK_S32 vpu_open_context(struct VpuCodecContext **ctx);
#ifdef __cplusplus
}
#endif
#ifdef __cplusplus
extern "C"
{
#endif
RK_S32 vpu_close_context(struct VpuCodecContext **ctx);
#ifdef __cplusplus
}
#endif

```

## 4. Process of Calling Decoder

**An example for decoding the video when the resolution is less than 720P @ 30fps:**

```
VpuCodecContext_t *_vpu_ctx = NULL;
```

### 4.1 Creating a Decoder

#### (1) Create \_vpu\_ctx

```

int ret = vpu_open_context(&_vpu_ctx);
if (ret < 0 || (_vpu_ctx == NULL))
{
    ERROR ("can not create context"); return -1;
}

```

#### (2) Initialize

```

_vpu_ctx->width = 1280;
_vpu_ctx->height = 720;/*resolution720P*/
_vpu_ctx->videoCoding = OMX_RK_VIDEO_CodingAVC;/*H264*/
_vpu_ctx->codecType = CODEC_DECODER;/*decoding*/

```

```
ret = _vpu_ctx->init(_vpu_ctx, NULL, 0); if (ret < 0)
{
    ERROR (" decoder init failed");
    return -1;
}
```

## 4.2 Applying the Decoder

```
VideoPacket_t pkt;
DecoderOut_t    picture;
VPU_FRAME* _vpu_fm;
memset(&pkt, 0, sizeof(VideoPacket_t));
memset(&picture, 0, sizeof(DecoderOut_t));
pkt.data = coded_data_ptr;
pkt.size = frame_len;

picture.data = (RK_U8*)_vpu_fm; picture.size = 0;
int ret = _vpu_ctx->decode(_vpu_ctx, &pkt, &picture);
if (ret != 0)
{
    ALOGE("[ER] failed to decode this frame"); return -1;
}
if (_vpu_fm->vpumem.vir_addr == NULL)
{
    It is required to cache two frames for decoding, and the data should be less than 30fps.
}
Note: The buffer should be released after the data has been used.
if (_vpu_fm->vpumem.vir_addr != NULL)
{
    VPUMemLink(&_vpu_fm->vpumem);
    VPUFreeLinear(&_vpu_fm->vpumem);
    memset(_vpu_fm, 0, sizeof(VPU_FRAME));
}
```

**Note:** The functions of decoder\_getstream, decoder\_sendframe and decode interface are the same.

## 4.3 Destroying the Decoder

```
if (_vpu_ctx != NULL)
{
    int res = vpu_close_context(&_vpu_ctx);
    _vpu_ctx = NULL;
}
```

## 5. Process of Calling Encoder

**An example for encoding the video when the resolution is less than 720P @ 30fps:**

```
VpuCodecContext_t *_vpu_ctx = NULL;
```

### 5.1 Creating a Encoder

#### (1) Create \_vpu\_ctx

```
int ret = vpu_open_context(&_vpu_ctx);
if (ret < 0 || (_vpu_ctx == NULL))
{
    ERROR ("can not create context"); return -1;
}
```

#### (2) Initialize

```
EncParameter_t *_vpu_enc_param;
_vpu_enc_param = (EncParameter_t*)malloc(sizeof(EncParameter_t)); memset(_vpu_enc_param,
0, sizeof(EncParameter_t));
_vpu_ctx->width = 1280;
_vpu_ctx->height = 720;/*resolution 720P*/
_vpu_ctx->videoCoding = OMX_RK_VIDEO_CodingAVC;/*H264*/
_vpu_ctx->codecType = CODEC_ENCODER;/*encoding*/
_vpu_enc_param->bitRate = 512;/*bit rate */
_vpu_enc_param->enableCabac = false;/*enabling cabac*/
_vpu_enc_param->cabacInitIdc = 0;
_vpu_enc_param->format = 0;
_vpu_enc_param->framerate =30;/*frame rate*/
_vpu_enc_param->width = 1280;
_vpu_enc_param->height = 720;
_vpu_enc_param->profileIdc = profile;
_vpu_enc_param->intraPicRate =_gop_len;
_vpu_enc_param->levelIdc = level_id;
_vpu_enc_param->rc_mode = 1;
_vpu_enc_param->qp = 35;
_vpu_ctx->private_data = _vpu_enc_param; ret =
_vpu_ctx->init(_vpu_ctx, NULL, 0); if (ret < 0)
{
    ERROR (" decoder init failed");
    return -1;
}
```

**/\*Obtain encoding parameters\*/**

```
EncParameter_t vpug;
_vpu_ctx->control(_vpu_ctx, VPU_API_ENC_GETCFG, (void*)&vpug);
```

**/\*Set encoding parameters\*/**

```
vpug.rc_mode = 1;
_vpu_ctx->control(_vpu_ctx,VPU_API_ENC_SETCFG,(void*)&vpug);
```

**/\*Set encoding type\*/**

```
H264EncPictureType encType = VPU_H264ENC_YUV420_SEMIPLANAR; //nv12
res=_vpu_ctx->control(_vpu_ctx,VPU_API_ENC_SETFORMAT,(void*)
&encType); if
(res < 0)
{
    ERROR ("init control failed!");
    return -1;
}
```

## 5.2 Applying the Encoder

```
EncInputStream_t input; /*Input the information of the image*/
input.buf = pic.viraddr /*The address of image*/
input.size = size; /*Image size*/
res = _vpu_ctx->encoder_sendframe(_vpu_ctx, &input);
if (res != 0)
{
    ERROR ("enc send frame to vpu error"); return -1;
}
EncoderOut_t output; /*The bit stream data after encoding*/ memset(&output, 0,
sizeof(EncoderOut_t));
output.data = NULL;
output.size = 0;          /*Bit stream size*/
res = _vpu_ctx->encoder_getstream(_vpu_ctx, &output);
if (res != 0)
{
    ERROR ("enc get frame to vpu error"); return -1;
}
```

**Note:** The functions of decoder\_getstream, decoder\_sendframe and encoder interface are the same.

## 5.3 Destroying the Encoder

```
if (_vpu_ctx != NULL)
{
    res = _vpu_ctx->flush(_vpu_ctx);
    if (res != 0)
    {
```

```
        ERROR ("enc flush vpu error"); return -1;
    }
    res = vpu_close_context(&_vpu_ctx); if (res != 0)
    {
        ERROR ("enc close vpu error"); return -1;
    }
    _vpu_ctx = NULL;
}
```

**Note:** It is required to apply for I-frame (Intra-coded picture) when packet loss occurs, and RK hardware encode does not support multi-slice encodes.