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Linux Interface Specification GStreamer

User's Manual: Software

R-Car H3/M3/M3N/E3 Series

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How to Use This Manual

- **[Readers]**

This manual is intended for engineers who develop products which use the R-Car H3/M3/M3N processor.

- **[Purpose]**

This manual is intended to give users an understanding of the functions of the R-Car H3/M3/M3N processor device driver and to serve as a reference for developing hardware and software for systems that use this GStreamer plug-in.

- **[How to Read This Manual]**

It is assumed that the readers of this manual have general knowledge in the fields of electrical

— engineering, logic circuits, microcontrollers, and Linux.

→ Read this manual in the order of the CONTENTS.

— To understand the functions of a multimedia processor for R-Car H3/M3/M3N

→ See the R-Car H3/M3 User's Manual.

— To know the electrical specifications of the multimedia processor for R-Car H3/M3/M3N

→ See the R-Car H3/M3 Data Sheet.

- **[Conventions]**

The following symbols are used in this manual.

Data significance: Higher digits on the left and lower digits on the right

Note: Footnote for item marked with Note in the text

Caution: Information requiring particular attention

Remark: Supplementary information

Numeric representation: Binary ... xxxx, 0bxxxx, or xxxxB

Decimal ... xxxx

Hexadecimal ... 0xxxxx or xxxxH

Data type: Word ... 32 bits

Half word ... 16 bits

Byte ... 8 bits

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1. Overview

1.1 Overview

This document explains the expanded specification of GStreamer Plug-in, and explains how to run the GStreamer Plug-in and GStreamer on Linux.

1.2 Reference

1.2.1 Related Documents

The following table shows the document related to this module.

Table 1 Related documents

Index	Document Name	Remarks
1	Linux Interface Specification Yocto recipe Start-up Guide	
2	Linux Interface Specification Device Driver V4L2	
3	Linux Interface Specification Device Driver Audio	
4	Linux Interface Specification Device Driver Display	
5	Linux Interface Specification Device Driver Video Capture	v2.56
6	OMX Media Component User's Manual (Audio/Video part)	
7	Linux Interface Specification Wayland	
8	Memory Manager for Linux	

1.3 Terminology

The following table shows the terminology related to this module.

Table 2 Terminology

Terms	Explanation
GStreamer	It provides functionality based on multimedia application such as Audio/Video in multimedia framework open source. URL: http://gstreamer.freedesktop.org/
GStreamer Plug-in	It is various Plug-in of GStreamer framework, provides other functionality and various codec.
OpenMAX	It is general multimedia API for embedded devices such as image, audio, ..., it consists three layers as below: OpenMAX AL (Application Layer) OpenMAX IL (Integration Layer) OpenMAX DL (Development Layer) URL: http://www.khronos.org/openmax/
gst-omx	GStreamer Plug-in that allows communication with OpenMAX IL component
Wayland	Wayland is a protocol that specifies the communication between the display server (called Wayland compositor) and its clients, as a replacement for the X Window System
Weston	Weston is the reference implementation of a Wayland compositor(typical elements of a window)

DRM	Direct Rendering Manager
KMS	Kernel Mode Setting

2. Operating Environment

2.1 Hardware Environment

The following table lists the hardware needed to use this module.

Table 3 Hardware

Index	Name	Remarks
1	R-CarH3-SiP System Evaluation Board Salvator-X / Salvator-XS	-

2.2 Software requirement

The following table lists the software needed to use this module.

Table 4 Software requirement

Index	Name	Remarks
1	R-CarH3/M3/M3N/E3 Linux BSP	-
2	Memory Manager	-
3	VSP Manager	-
4	UVCS Driver	-
5	OMX (Video/Audio)	-
6	VSP2 Driver	-
7	Wayland/Weston	-

2.3 Module Configuration

This section shows the software configuration in which GStreamer is used.

2.3.1 Video playback

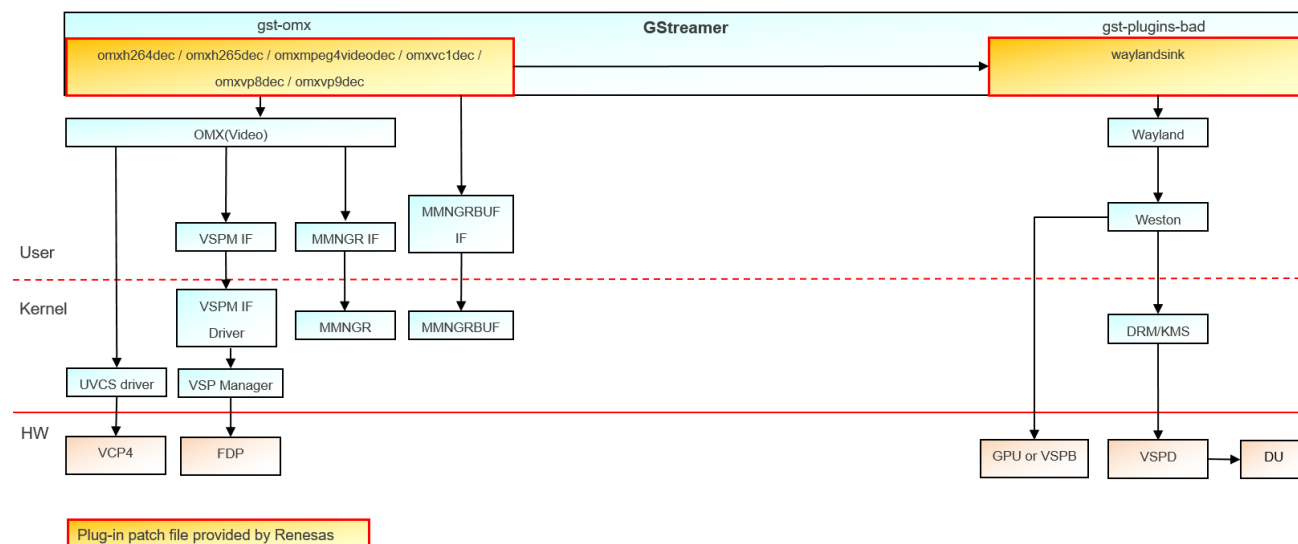


Figure 1 Video playback

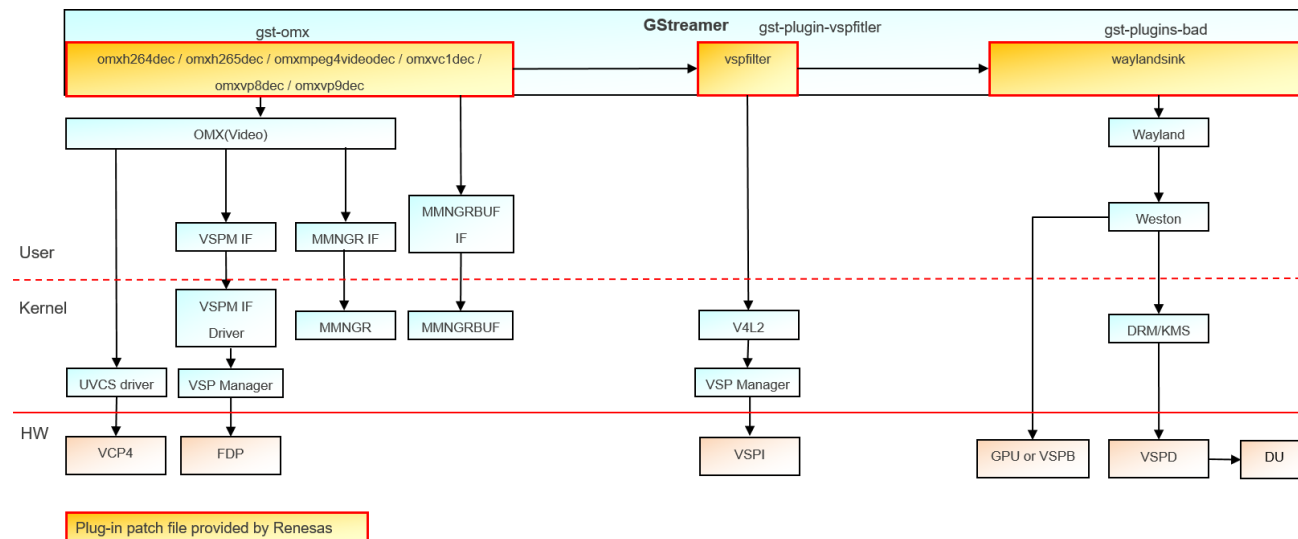


Figure 2 Video playback (scaling and color conversion)

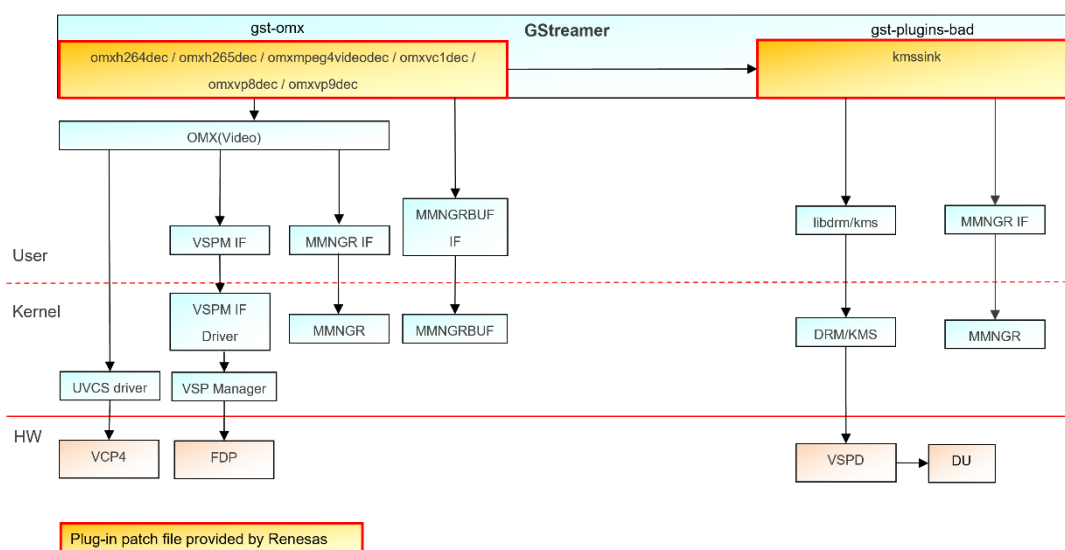


Figure 3 Video playback (kmssink)

2.3.2 Audio playback

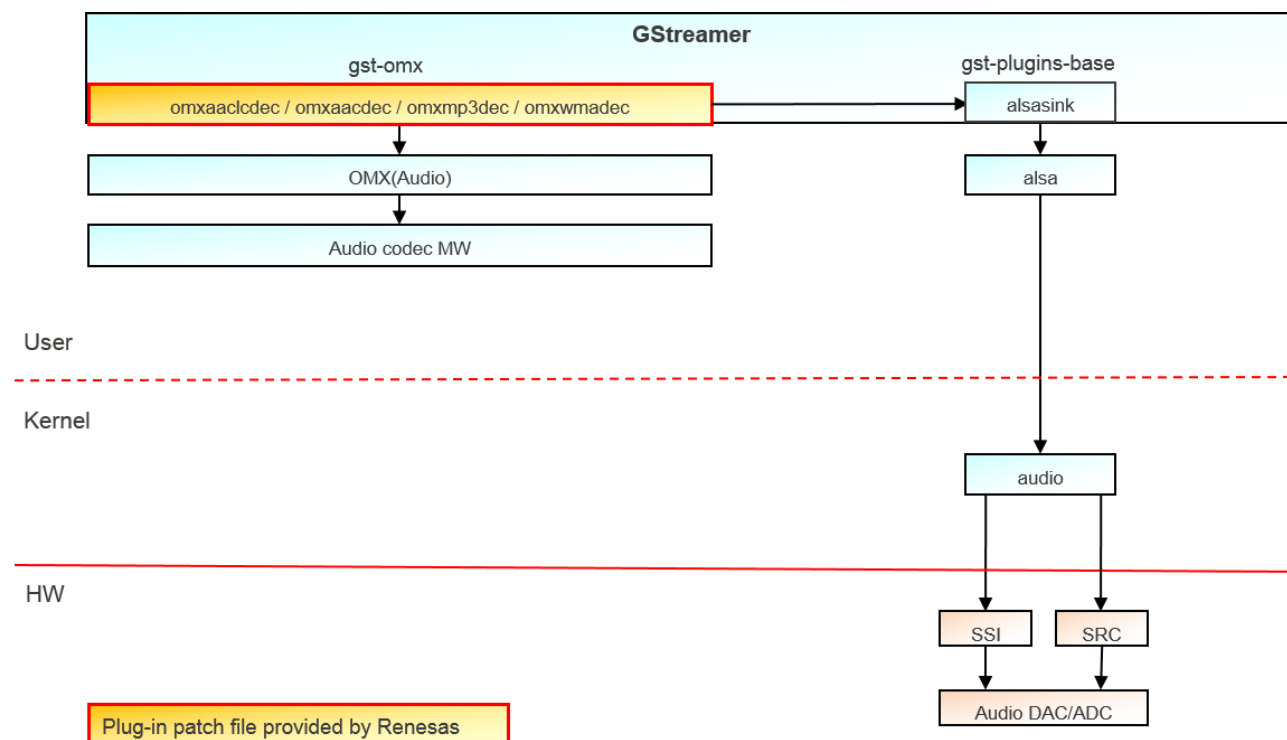


Figure 4 Audio playback

2.3.3 Video capture and display

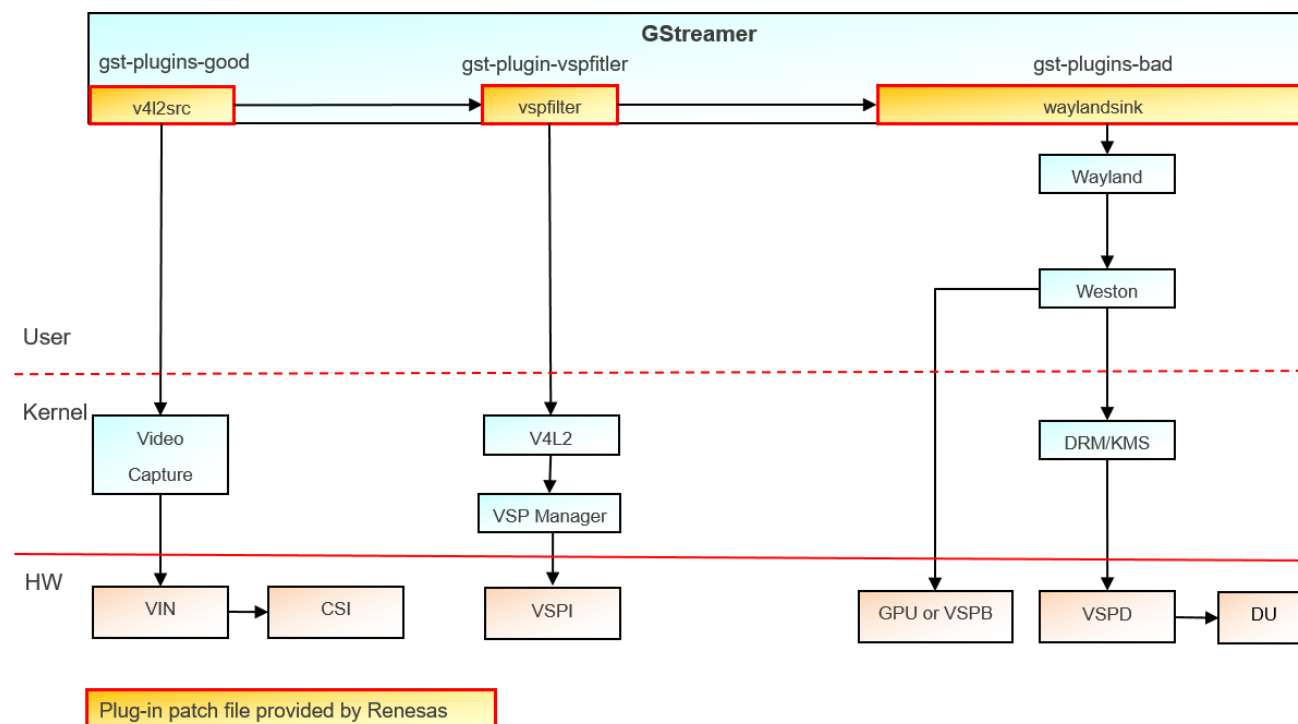


Figure 5 Video capture and display

2.3.4 Video capture and encode

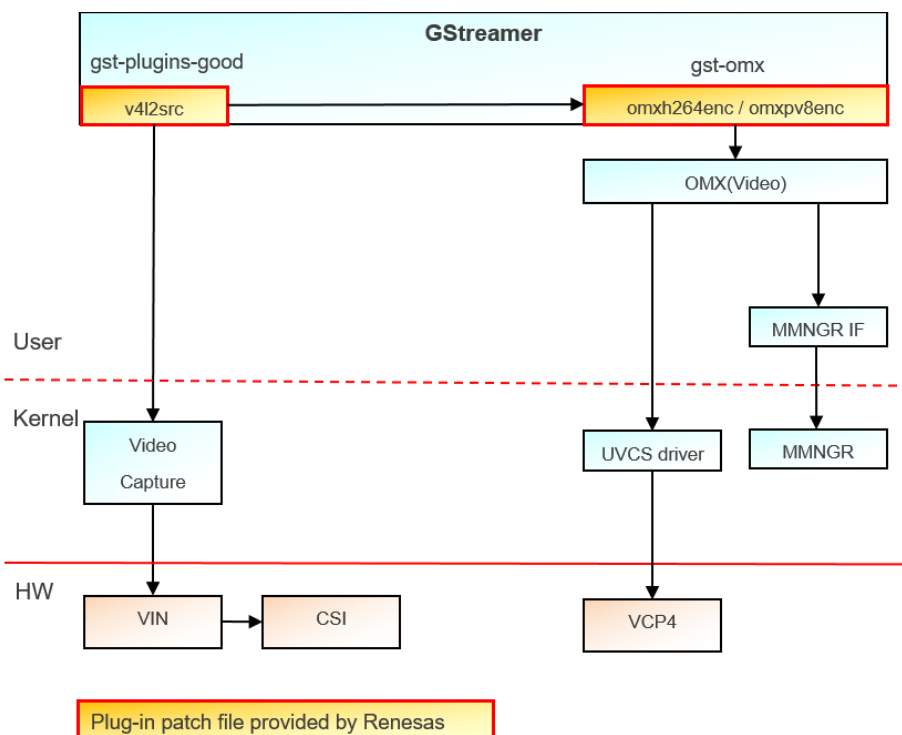


Figure 6 Video capture and encode

2.3.5 Video crop and display

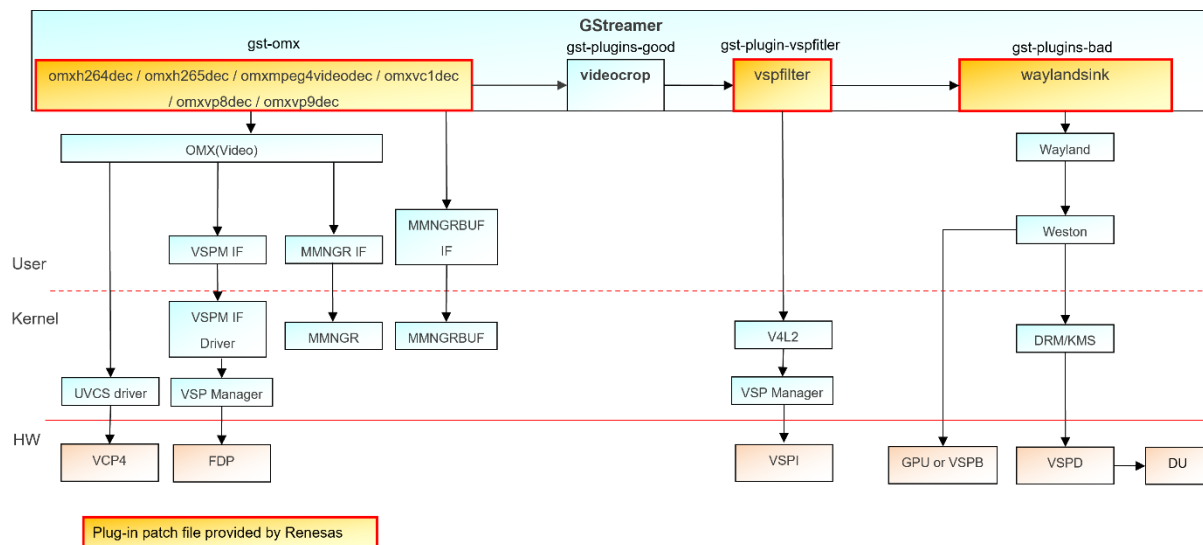


Figure 7 Video crop and display

3. Plug-ins and elements information

3.1 GStreamer and GStreamer Plug-in

Table 5 GStreamer and GStreamer plug-in

Index	Name	License	Version	Remarks
1	GStreamer core	LGPL ver2	1.16.3	Downloaded by Yocto
2	GStreamer Base plugins	LGPL ver2	1.16.3	Downloaded by Yocto
3	GStreamer Good plugins	LGPL ver2.1	1.16.3	Downloaded by Yocto
4	GStreamer Bad plugins	GPL ver2	1.16.3	Downloaded by Yocto
5	GStreamer Ugly plugins	LGPL ver2.1	1.16.3	Downloaded by Yocto
6	GStreamer gst-omx plugins	LGPL ver2.1	1.16.3	Downloaded by Yocto
7	gst-plugins-good plug-in patch files (include v4l2src)	LGPL ver2.1	-	Downloaded by Yocto (*1)
8	gst-plugins-bad plug-in patch files (include waylandsink and kmssink)	LGPL ver2.1	-	Downloaded by Yocto (*1)
9	gst-omx plug-in patch files (include omxh264dec, omxmpeg4videodec, omxvc1dec, omxh265dec, omxvp8dec, omxvp9dec, omxaacldec, omxaacdec, omxmp3dec, omxwmadec, omxh264enc, omxvp8enc)	LGPL ver2.1	-	Downloaded by Yocto (*1)
10	gst-plugin-vspfilter (include vspfilter)	LGPL ver2.1	-	Downloaded by Yocto (*1)

*1: URL: <https://github.com/renesas-rcar>

3.2 Elements

The main elements customized by Renesas are explained below. The properties added by Renesas are explained as “Expansion Properties”.

Table 6 Video Decoder elements

Element Name	Element Explanation	Expansion Properties	
		Property	Property Explanation
(common contents in all of the decoder)	Support NV12 and I420 as the output format	no-copy (*1)	Do not copy output data in gst-omx. Share output buffer with element of downstream. Export userptr to downstream for buffer sharing.
			TRUE Copyless
			FALSE(default*2) Copy (general purpose)
		use-dmabuf (*1)	Do not copy output data in gst-omx. Use DMA buffer sharing framework (DMABUF) Export DMABUF to downstream for buffer sharing.
			TRUE(default*2) Use DMABUF
			FALSE Does not use DMABUF (same as “no-copy=FALSE”)
		no-reorder	Set the output picture reordering.
			TRUE Output picture data in decoding order Note) The video file including B-Frames can't be displayed correctly.
			FALSE(default) Output picture data in display order
			Refer to OMX Media Component User's Manual: Video Decoder Common Part.
omxh264dec	H.264 Decoder Element	lossy-compress	Use lossy compression mode(*3)
			TRUE Use lossy compression mode
			FALSE(default) Does not use lossy compression mode
			Refer to OMX Media Component User's Manual: Video Decoder Common Part.
		enable-crop	Whether or not to enable cropping if there is cropping information of decoded result.
			TRUE(*4) Enable
			FALSE(default) Disable
		use-2ndhwip	Whether or not use another Video Hardware IP to decode (*5)
			TRUE Enable (use iVDP1C)
			FALSE(default) Disable (use VCP4)
omxmpeg4videodec	MPEG4Video Decoder Element	-	(No expansion properties)
omxvc1dec	VC-1 Decoder Element	-	(No expansion properties)
omxh265dec	H.265 Decoder Element	-	(No expansion properties)

omxvp8dec	VP8 Decoder Element	-	(No expansion properties)
omxpv9dec	VP9 Decoder Element	-	(No expansion properties)

*1: Select one, either “no-copy” or “use-dmabuf” option.

When you specify neither “no-copy” nor “use-dmabuf” option, omxh264dec works as “use-dmabuf=TRUE”.

*2: Default value can be changed by gstomx.conf. Refer to 5.1.

*3: The output format of lossy compression mode is restricted to I420.

Please refer to OMX Media Component User's manual for details of lossy compression mode.

*4: Please use this option with use-dmabuf=true in case downstream is waylandsink. However, Wayland screen can disappear instead of display incorrect with YUV 4:2:0 format (NV12 or I420) if cropping values don't align for 4. Please convert BGRA format using vspfilter in this case.

*5: When enable use-2ndhwip in omxh264dec, iVDP1C will be chosen for decode instead of VCP4.

Please refer to OMX Media Component User's manual for more detail support of this Hardware IP.

Table 7 Audio Decoder elements

Element Name	Element Explanation	Expansion Properties	
		Property	Property Explanation
omxaaclddec	AAC-LC Decoder Element	-	(No expansion properties)
omxaacdec	AAC Plus Decoder Element	down-mix	Whether or not use down mix function for output channel.
			TRUE(default) Output channel is 2 always.
			FALSE Output channel is 1, 2, or 6.
omxmp3dec	MP3 Decoder Element	-	(No expansion properties)
omxwmadec	WMA Decoder Element	-	(No expansion properties)

Table 8 Video Encoder elements

Element Name	Element Explanation	Expansion Properties		
		Property	Property Explanation	
(common contents in all of the encoder)	Support NV12 and I420 as the input format	no-copy	Do not copy input data in gst-omx. Share input buffer with element of upstream. Export userptr to upstream for buffer sharing.	
			TRUE	Copyless.
			FALSE(default)	Copy (general purpose)
		use-dmabuf (*1)	Do not copy input data in gst-omx. Use DMA buffer sharing framework (DMABUF) Import DMABUF from upstream for buffer sharing.	
			TRUE	Use DMABUF
			FALSE(default)	Does not use DMABUF (same as “no-copy=FALSE”)
omxh264enc	H.264 Encoder Element	scan-type	Set encode scan type	
			0	Progressive
			4	Interlaced top field first
			5	Interlaced bottom field first
			-1	OMX default
		send-eos	Send EOS/EOF stream data to downstream	
			TRUE	Send
			FALSE(default)	NOT send
		b-frames	Number of b-frames (This property does not support with no-copy=TRUE)	
		ref-frames	Number of reference frames	
		use-incaps-header	This option support for cases connect directly omxh264enc and omxh264dec (This property is deprecated because this setting is not necessary in the latest version)	
TRUE	Enable			
FALSE(default)	Disable			
omxvp8enc	VP8 Encoder Element	dct-partitions	DCT residual data partition	
			0	1 DCT residual data partition.
			1	2 DCT residual data partition.
		Interval_intraframes	Interval of coding Intra frames Default is 29	
		sharpness	Control the blocking filter Default is 0	

*1: In case dmabuf buffer from upstream falls to alignment restriction of encoder (refer to OMX User manual of encoder). Please use default mode (no-copy=false) of encoder.

Table 9 Sink elements

Element Name	Explanation	Expansion Properties	
		Property	Property Explanation
waylandsink	Sink elements for Wayland/Weston Support BGRA and NV12(*1) as the input format	use-subsurface	When disabled, a subsurface will not be created from an externally-supplied surface (e.g. needed for scanout when the application's surface is fullscreen)
			TRUE(default) Use subsurface
			FALSE NOT use subsurface
		suppress-interlace	Suppress the buffer flag of interlace (e.g. Use if wayland / weston does not support the interlace flag)
			TRUE(default) Suppress the buffer flag of interlace
			FALSE Not suppress the buffer flag of interlace
kmssink	Sink elements for kms/drm Support BGRA, BGRx, RGB, BGR, UYVY, YUY2, YVYU, I420, YV12, Y42B, NV12, NV21, NV16 as the input format	driver-name	DRM device driver name This property is standard implementation. The available setting is as following.
			null (default) Default setting
			rcar-du Use Renesas DU driver
		connector-id	This property is standard implementation. DRM connector id (Ex. HDMI, Analog or LVDS). For example, in R-Car H3:
			Connectors ID
			R-Car H3 Analog: 69 HDMI0: 71 HDMI1: 74 LVDS: 77
			Please refer "Linux Interface Specification Device Driver Display User's Manual" about list of DRM resources ID for detail information.
		force-modesetting	When enabled, the sink tries to configure the display mode This property is standard implementation. The available setting is as following.
			TRUE Enforce mode setting in the kms sink and output to the base plane (*2)
			FALSE (default) Uses an overlay plane
		write-back	Capture a screenshot the display. Screenshot will be record into ./recorder.bin. It is video raw file with BGRA format.
			TRUE Capture a screenshot of the final frame and record it into recorder.bin(*3).
			FALSE (default) No capture screenshot

*1: When use NV12 format, the buffer from upstream supports only dmabuf. The element which does not support dmabuf such as videotestsrc cannot be connected using NV12.

*2: When enable "force-modesetting", display device will be configured as input resolution. Please refer to "Linux Interface Specification Device Driver Display User's Manual" for supported display resolution of connectors.

*3: When enable write-back, recorder.bin will record a screenshot of display. The resolution is resolution of display, it may be bigger than input resolution. Can use "-v" option of gst-launch-1.0 to check for display resolution. It will print information as following:

```
/GstPipeline:pipeline0/GstKMSSink:kmssink0: display-width = 1280
/GstPipeline:pipeline0/GstKMSSink:kmssink0: display-height = 800
```

Table 10 Src elements

Element Name	Explanation	Expansion Properties	
		Property	Property Explanation
v4l2src	Reads frames from a Video4Linux2 device Support UYVY, YUY2, RGB16, BGRx, NV16 and NV12 as the output format	crop-top	The top corner of the CROP area on input image, Default is 0.
		crop-left	The left corner of the CROP area on input image, Default is 0.
		crop-width	The width of crop area, Default is 0.
		crop-height	The height of crop area, Default is 0.
		io-mode	This property is standard implementation. The available setting is as following.
			auto(default) Auto
			mmap Use mmap
			dmabuf Use dmabuf
			userptr Use userptr
		no-resurrect-buf	This property is that skip resurrect buffer when all buffers in queue used up. Please set true when sharing buffers with downstream such as encoder. (<i>This property is deprecated in latest version</i>)
			TRUE Enable
			FALSE(default) Disable
		num-alloc-buffer	Change number of buffer in v4l2src. It is used for debugging purpose.

Note:

* crop-top + crop-height <= height of input image

* crop-left + crop-width <= width of input image

Table 11 Video convert elements

Element Name	Explanation	Expansion Properties	
		Property	Property Explanation
vspfilter	vspfilter controls scaling and color space conversion by VSPI. Support RGB16, BGRx, I420, UYVY, YUY2, NV16 and NV12 as the input format. Support BGRA, NV12 as the output format.	devfile-input	VSP device file name for input port Default: refer to /etc/gstvspfilter.conf
		devfile-output	VSP device file name for output port Default: refer to /etc/gstvspfilter.conf
		input-io-mode	Decide input I/O mode.
			0 (default) auto (dmabuf or mmap *4)
			1 userptr
		output-io-mode	Decide output I/O mode.
			0 (default) auto (dmabuf or mmap)
			1 userptr
		input-color-range	The range information different from colorimetry included input caps can be overwritten
			0 (auto) forcibly apply V4L2_QUANTIZATION_DEFAULT
			1 (full) forcibly apply V4L2_QUANTIZATION_FULL_RANGE
			2 (limited) forcibly apply V4L2_QUANTIZATION_LIM_RANGE
			-1 (default) apply from input caps information

*4: If it is possible to send the dmabuf from the connection source, it uses dmabuf. Otherwise it uses mmap.

4. Example of how to use the plug-in

An example of a GStreamer plug-ins using gst-launch is explained.

4.1 Initialization

Please process (1)-(3) after a board start-up.

(1) Setting audio mixer

```
amixer set "DVC Out" 1%
```

(2) Load kernel modules

```
# modprobe -a mmngr mmngrbuf vspm_if uvcs_drv
```

(3) Setting vspfilter

Please execute following commands and modify “/etc/gstvspfilter.conf” if Linux kernel provided by Renesas is modified.

Example using VSPI0 of H3

```
# media-ctl -d /dev/media3 -e "fe9a0000.vsp rpf.0 input"
# media-ctl -d /dev/media3 -e "fe9a0000.vsp wpf.0 output"
```

Execution example:

```
# media-ctl -d /dev/media3 -e "fe9a0000.vsp rpf.0 input"
/dev/video20
# media-ctl -d /dev/media3 -e "fe9a0000.vsp wpf.0 output"
/dev/video21
```

/etc/gstvspfilter.conf is edited as follows:

```
input-device-name=/dev/video20
output-device-name=/dev/video21
```

The device file name(/dev/media*) is an example.

Depending on the user's environment, the name of the device file may change.

Please refer to "Linux Interface Specification Device Driver V4L2 User's Manual" about /dev/media* corresponding to VSPI device.

(4) Setting VIN driver

When using v4l2src, please set up the VIN driver beforehand. For details, please refer to the manual of the VIN driver

Example using HDMI (VIN0: 1920x1080p)

```
# media-ctl -d /dev/media0 -l "'rcar_csi2 feaa0000.csi2':1 -> 'VIN0 output':0 [1]"
# media-ctl -d /dev/media0 -l "'adv748x 4-0070 hdmi':1 -> 'adv748x 4-0070 txa':0 [1]"
# media-ctl -d /dev/media0 -V "'rcar_csi2 feaa0000.csi2':1 [fmt:RGB888_1X24/1920x1080 field:none]"
# media-ctl -d /dev/media0 -V "'adv748x 4-0070 txa':0 [fmt:RGB888_1X24/1920x1080 field:none]"
```

Example using HDMI (VIN0: 1920x1080i)

```
# media-ctl -d /dev/media0 -l "'rcar_csi2 feaa0000.csi2':1 -> 'VIN0 output':0 [1]"
# media-ctl -d /dev/media0 -l "'adv748x 4-0070 hdmi':1 -> 'adv748x 4-0070 txa':0 [1]"
# media-ctl -d /dev/media0 -V "'rcar_csi2 feaa0000.csi2':1 [fmt:RGB888_1X24/1920x540 field:alternate]"
# media-ctl -d /dev/media0 -V "'adv748x 4-0070 txa':0 [fmt:RGB888_1X24/1920x540 field:alternate]"
```

Example using CVBS (VIN5: 720x480i)

```
# media-ctl -d /dev/media0 -l "'rcar_csi2 fea80000.csi2':1 -> 'VIN5 output':0 [1]"
# media-ctl -d /dev/media0 -l "'adv748x 4-0070 afe':8 -> 'adv748x 4-0070 txb':0 [1]"
# media-ctl -d /dev/media0 -V "'rcar_csi2 fea80000.csi2':1 [fmt:UYVY2X8/720x240 field:alternate]"
# media-ctl -d /dev/media0 -V "'adv748x 4-0070 afe':8 [fmt:UYVY2X8/720x240 field:alternate]"
```

4.2 Up/Down scaling using vspfilter

Up/Down Scaling is operated by VSPi which is controlled in “vspfilter” plug-in.

Following are sample commands for Up/Down Scaling with h264 Elementary Stream file.

(1) Case of Up Scaling

```
# gst-launch-1.0 filesrc location=./<HDsize_h264_file> ! h264parse ! queue ! omxh264dec ! queue ! \
vspfilter ! video/x-raw, format=BGRA, width=1920, height=1080 ! waylandsink
```

(2) Case of Down Scaling

```
# gst-launch-1.0 filesrc location=./<FullHDsize_h264_file> ! h264parse ! queue ! omxh264dec ! queue ! \
vspfilter ! video/x-raw, format=BGRA, width=1280, height=720 ! waylandsink
```

(3) Case of Down Scaling (without color format conversion)

```
# gst-launch-1.0 filesrc location=./<FullHDsize_h264_file> ! h264parse ! queue ! omxh264dec ! queue ! \
vspfilter ! video/x-raw, width=1280, height=720 ! waylandsink
```

The displayed location cannot be set, it's decided by setting Wayland shell (It's desktop-shell).

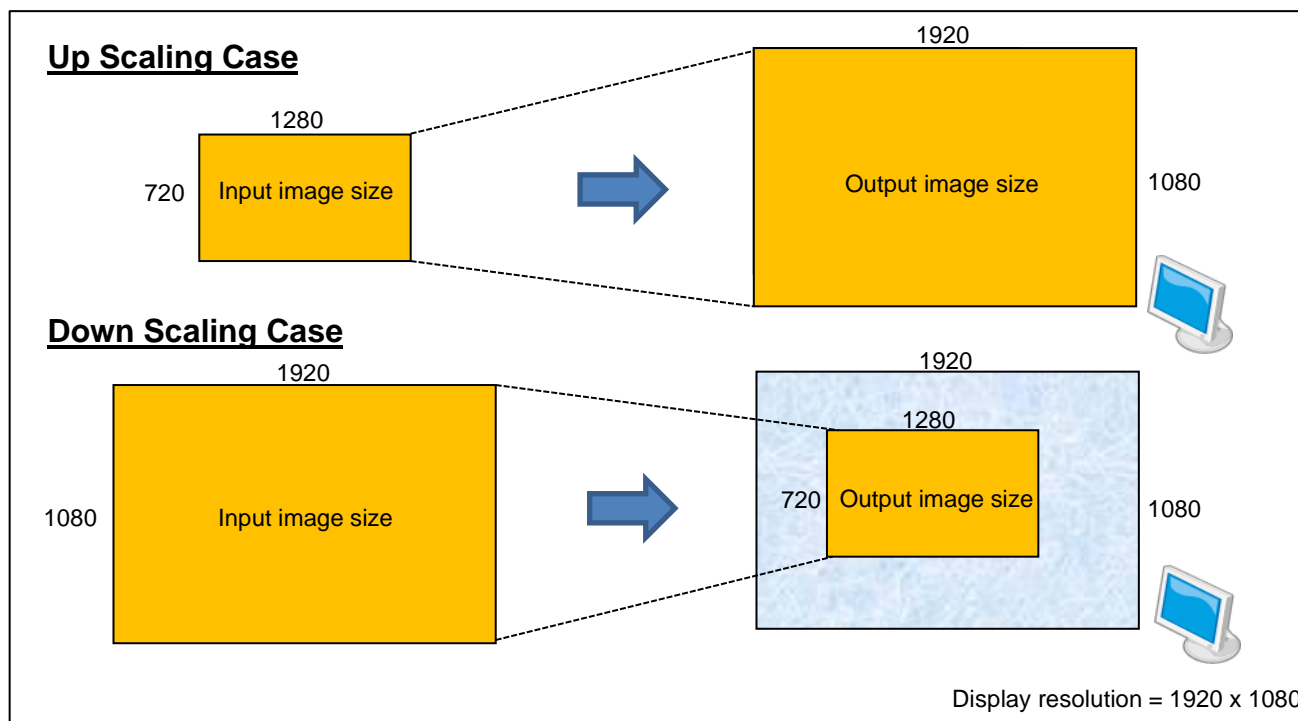


Figure 8 Up/Down scaling

4.3 Color format conversion using vspfilter

Color format conversion is operated by VSPI which is controlled in “vspfilter” plug-in.

Please set the output format which begin supported following “format=”.

(1) Case of BGRA output

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux ! queue ! h264parse ! omxh264dec ! queue ! \
vspfilter ! video/x-raw, format=BGRA ! waylandsink
```

(2) Case of NV12 output

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux ! queue ! h264parse ! omxh264dec ! \
video/x-raw, format=I420 ! queue ! vspfilter ! video/x-raw, format=NV12 ! waylandsink
```

4.4 Video playback examples

(1) H.264 decoding example of MP4 container file

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux ! queue ! h264parse ! omxh264dec ! waylandsink
```

(2) H.264 decoding example of elementary stream file

```
# gst-launch-1.0 filesrc location=filename.264 ! h264parse ! queue ! omxh264dec ! waylandsink
```

(3) MPEG4Video decoding example of MP4 container file

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux ! queue ! mpeg4videoparse ! omxmpeg4videodec ! \
waylandsink
```

(4) MPEG4Video decoding example of elementary stream file

```
# gst-launch-1.0 filesrc location=filename.m4v ! mpeg4videoparse ! queue ! omxmpeg4videodec ! waylandsink
```

(5) VC-1 decoding example of ASF container file

```
# gst-launch-1.0 filesrc location=filename.wmv ! asfdemux ! queue ! omxvc1dec ! waylandsink
```

(6) H.265 decoding example of MP4 container file

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux ! queue ! h265parse ! omxh265dec ! waylandsink
```

(7) H.265 decoding example of elementary stream file

```
# gst-launch-1.0 filesrc location=filename.265 ! h265parse ! queue ! omxh265dec ! waylandsink
```

(8) VP8 decoding example of Matroska container file

```
# gst-launch-1.0 filesrc location=filename.mkv ! matroskademux ! queue ! omxvp8dec ! waylandsink
```

(9) VP9 decoding example of WebM container file

```
# gst-launch-1.0 filesrc location=filename.webm ! matroskademux ! queue ! omxvp9dec ! waylandsink
```


(10) Video framerate control example

When the refresh rate of display is lower than the video framerate, it should add videorate element. By using videorate element, it will reduce the video framerate.

```
# gst-launch-1.0 filesrc location=filename_60fps.mp4 ! qtdemux ! queue ! h264parse ! omxh264dec ! queue ! \
videorate ! video/x-raw, framerate=30/1 ! vspfilter ! video/x-raw, format=BGRA ! waylandsink qos=false
```

Because controlling the framerate by videorate element, qos event of waylandsink had better set false.

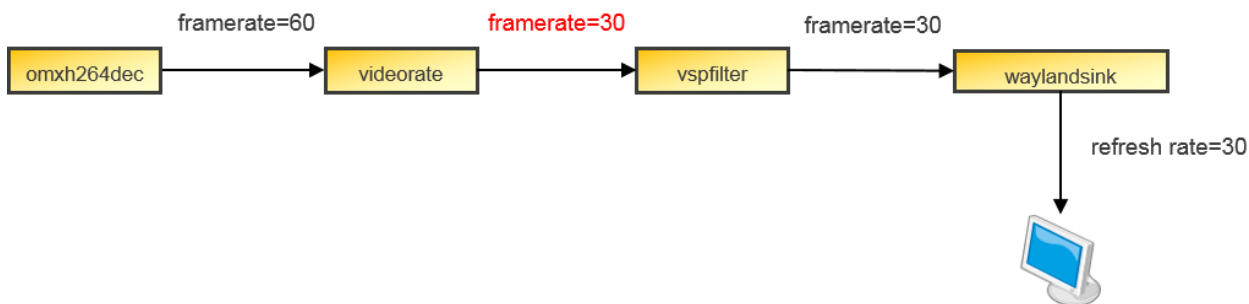


Figure 9 Video framerate control

(11) Video playback with kmssink

Stop weston before using kmssink:

```
# systemctl stop weston@root
```

Display on HDMI0 of R-CarH3:

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux ! queue ! h264parse ! omxh264dec ! kmssink driver-
name=rcar-du connector-id =71
```

Capture a screenshot of display ^{(*)1}:

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux ! queue ! h264parse ! omxh264dec ! kmssink driver-
name=rcar-du connector-id =71 write-back=true
```

*1: Screenshot file: recorder.bin (BGRA format). Please ensure mmngr was inserted and if there is no data in recorder.bin, please use with option “-e” (gst-launch -e) to ensure eos and query for drain.

Display with force-modesetting ^{(*)2}:

```
# gst-launch-1.0 filesrc location=file_1920x1080.mp4 ! qtdemux ! queue ! h264parse ! omxh264dec ! kmssink
driver-name=rcar-du connector-id =71 force-modesetting=true
```

*2: with force-modesetting=true, kmssink can display with supported resolutions of rcar-du only. Following is supported resolution of HDMI in R-Car H3. For more detail information, please refer to “Linux Interface Specification Device Driver Display User’s Manual” or use command “modetest -M rcar-du” to verify for connectors in system.

HDMI Display resolution	
VGA (640x480)	FWXGA (1280x720)
WVGA (800x480)	WXGA (1280x768)
SVGA (800x600)	1920x1080
WSVGA (1024x600)	WUXGA (1920x1200)
XGA (1024x768)	4k (3840x2160)

For other resolutions, please use vspfilter to scale to support resolutions or use videocrop to crop to support resolution. Recommend using videocrop in BGRA format or can meet incorrect color display.

(12) Video playback with the second Hardware IP

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux ! queue ! h264parse ! omxh264dec use-2ndhwip=true !  
waylandsink
```

4.5 Audio playback examples

(1) AAC-LC (or AAC) decoding example of MP4 container file

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux ! queue ! omxaaclddec ! alsasink device=plughw:0,0
```

When using audio MW which HE-AAC format is supported, please change the name of the decoder element to 'omxaacdec'.

(2) AAC-LC (or AAC) decoding example of adts file

```
# gst-launch-1.0 filesrc location=filename.aac ! aacparse ! queue ! omxaaclddec ! alsasink device=plughw:0,0
```

When using audio MW which HE-AAC format is supported, please change the name of the decoder element to 'omxaacdec'.

(3) MP3 decoding example of elementary stream file

```
# gst-launch-1.0 filesrc location=filename.mp3 ! mpegaudioparse ! omxmp3dec ! alsasink device=plughw:0,0
```

(4) WMA decoding example of ASF container file

```
# gst-launch-1.0 filesrc location=filename.wma ! asfdemux ! queue ! omxwmadec tolerance=0x7fffffffffffffff !  
alsasink device=plughw:0,0
```

Please add "tolerance" option to omxwmadec for correct synchronous control.

By setting maximum value to "tolerance" option, timestamp of output buffer will be calculated based on size of buffer.

WMA decoder might perform decode output once per multiple inputs depending on a stream.

In this case, a warning of "still frames left after draining" is displayed, but decoding is done normally.

(5) Audio resampling and channel conversion example

When decoded PCM data do not match supported format of alsa device, it can playback by converting PCM data.

The following example converts output sampling frequency to 48000Hz.

```
# gst-launch-1.0 filesrc location=filename_24000Hz.mp4 ! qtdemux ! queue ! omxaaclddec ! \  
audioresample ! audio/x-raw, rate=48000 ! alsasink device=plughw:0,0
```

The following example converts it to the number of the channels that alsa supports.

```
# gst-launch-1.0 filesrc location=filename_aac_1ch.mp4 ! qtdemux ! queue ! omxaaclddec ! \  
audioconvert ! alsasink device=plughw:0,0
```

4.6 Audio and Video playback examples

(1) H.264 and AAC-LC (or AAC) decoding example of MP4 container file

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux name=demux \
demux.audio_0 ! queue ! omxaaclddec ! alsasink device=plughw:0,0 \
demux.video_0 ! queue ! h264parse ! omxh264dec ! queue ! vspfilter ! \
video/x-raw, format=BGRA, width=<output width>, height=<output height> ! waylandsink
```

(2) MPEG4Video and AAC-LC (or AAC) decoding example of MP4 container file

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux name=demux \
demux.audio_0 ! queue ! omxaaclddec ! alsasink device=plughw:0,0 \
demux.video_0 ! queue ! mpeg4videoparse ! omxmpeg4videodec ! queue ! vspfilter ! \
video/x-raw, format=BGRA, width=<output width>, height=<output height> ! waylandsink
```

(3) VC-1 and WMA decoding example of ASF container file

```
# gst-launch-1.0 filesrc location=filename.wmv ! asfdemux name=demux \
demux.audio_0 ! queue ! omxwmadec tolerance=0x7fffffff ! alsasink device=plughw:0,0 \
demux.video_0 ! queue max-size-time=0 ! omxvc1dec ! queue ! vspfilter ! \
video/x-raw, format=BGRA, width=<output width>, height=<output height> ! waylandsink
```

Please add “tolerance” option to omxwmadec for correct synchronous control.

Please add “max-size-time” option to queue of video path for buffering of Audio/Video data.

(4) H.265 and AAC-LC (or AAC) decoding example of MP4 container file

```
# gst-launch-1.0 filesrc location=filename.mp4 ! qtdemux name=demux \
demux.audio_0 ! queue ! omxaaclddec ! alsasink device=plughw:0,0 \
demux.video_0 ! queue ! h265parse ! omxh265dec ! queue ! vspfilter ! \
video/x-raw, format=BGRA, width=<output width>, height=<output height> ! waylandsink
```

4.7 Video capture examples

The device file name (/dev/video*) is an example.

Depending on the user's environment, the name of the device file may change.

Please refer to "Linux Interface Specification Device Driver Video Capture User's Manual" [5] about /dev/video* corresponding to Video capture device.

(1) Capture from HDMI (Example of when HDMI_in is /dev/video0)

```
# gst-launch-1.0 v4l2src device=/dev/video0 num-buffers=1 ! \
video/x-raw, format={RGB16/YUY2/YUYV/BGRx/NV16/NV12} ! \
filesink location=output.bin
```

(2) Capture from RCA (Example of when RCA_in is /dev/video5)

```
# gst-launch-1.0 v4l2src device=/dev/video5 num-buffers=1 ! \
video/x-raw, format={RGB16/YUY2/YUYV/BGRx}, interlace-mode=interleaved ! \
filesink location=output.bin
```

```
# gst-launch-1.0 v4l2src device=/dev/video5 num-buffers=1 \
crop-top=0 crop-left=0 crop-width=736 crop-height=480 ! \
video/x-raw, format={NV16/NV12}, width=736, height=480, interlace-mode=interleaved ! \
filesink location=output.bin
(*1)
```

(*1) Notes: At the time of NV16/NV12 format specification, the capture output width should be specified the value of the multiple of 32 by the specification of H/W. Please refer to the User's manual of Video capture driver.

(3) Capture with scaling

```
# gst-launch-1.0 v4l2src device=/dev/video0 num-buffers=1 ! \
video/x-raw, format={RGB16/YUY2/YUYV/BGRx/NV16}, width=960, height=544 ! \
filesink location=output.bin
(*2)
```

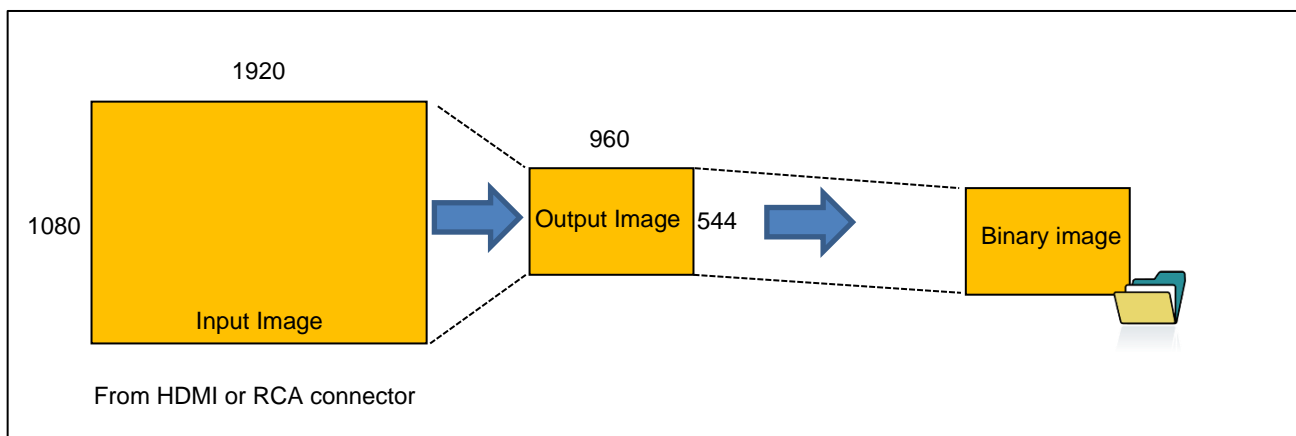
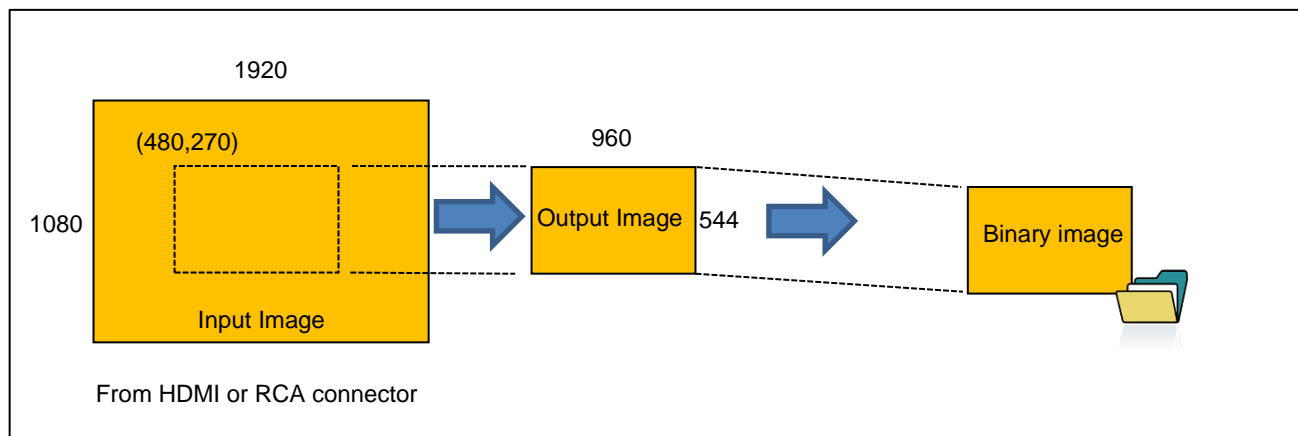


Figure 10 Capture with scaling

(*2) Notes: At the time of horizontal scaling, the value of output width should be specified the multiple of 32. Scaling of NV12 format is prohibited by H/W specification. The value of output height should be specified the same value as an input vertical size with NV12 format. Please refer to the User's manual of Video capture driver.

(4) Capture with cropping

```
# gst-launch-1.0 v4l2src device=/dev/video0 num-buffers=1 \  
crop-top=480 crop-left=270 crop-width=960 crop-height=544 ! \  
video/x-raw, format={RGB16/YUY2/UYYV/BGRx/NV16/NV12}, width=960, height=544 ! \  
filesink location=output.bin  
(*1)
```

**Figure 11 Capture with cropping**

4.8 Video capture and display examples

When Ctrl + C is pressed, the capture can be stopped.

(1) Capture from HDMI (Example of when HDMI_in is /dev/video0) and display

```
# gst-launch-1.0 v4l2src device=/dev/video0 io-mode=dmabuf ! \
video/x-raw, format={RGB16/UYVY/BGRx/NV12} ! \
queue ! vspfilter ! video/x-raw, format=BGRA ! waylandsink
```

(2) Capture from RCA (Example of when RCA_in is /dev/video5) and display

```
# gst-launch-1.0 v4l2src device=/dev/video5 io-mode=dmabuf ! \
video/x-raw, format={RGB16/UYVY/BGRx}, interlace-mode=interleaved ! \
queue ! vspfilter ! video/x-raw, format=BGRA ! waylandsink
```

```
# gst-launch-1.0 v4l2src device=/dev/video5 io-mode=dmabuf ! \
video/x-raw, format=NV12,width=736,height=480,interlace-mode=interleaved ! \
queue ! vspfilter ! video/x-raw, format=BGRA ! waylandsink
(*1)
```

(*1) Notes: At the time of NV12 format specification, the capture output width should be specified the value of the multiple of 32 by the specification of H/W. Please refer to the User's manual of Video capture driver.

(3) Capture and Scaling using vspfilter

```
# gst-launch-1.0 v4l2src device=/dev/video0 io-mode=dmabuf ! \
video/x-raw, format=NV12, width=1920, height=1080 ! \
queue ! vspfilter ! video/x-raw, format=NV12, width=640, height=480 ! waylandsink
(*2)
```

(*2) Notes: When using v4l2src and vspfilter in scaling case in the same format, please make clear output resolution of v4l2src (or input resolution of vspfilter)

4.9 Video capture and encoding examples

(1) H.264 encoding example (dmabuf)

```
# gst-launch-1.0 v4l2src device=/dev/video0 num-buffers=300 io-mode=dmabuf no-resurrect-buf=true ! \
video/x-raw,format=NV12, framerate=60/1 ! \
omxh264enc control-rate=2 target-bitrate=10485760 interval_intraframes=14 periodicity-idr=2 \
use-dmabuf=true ! \
video/x-h264,profile=(string)high,level=(string)4.2 ! h264parse ! \
video/x-h264,stream-format=avc,alignment=au ! qtmux ! queue ! filesink location=output.mp4
```

(2) H.264 encoding example (userptr)

```
# gst-launch-1.0 v4l2src device=/dev/video0 num-buffers=300 io-mode=userptr no-resurrect-buf=true ! \
video/x-raw,format=NV12, framerate=60/1 ! \
omxh264enc control-rate=2 target-bitrate=10485760 interval_intraframes=14 periodicity-idr=2 no-copy=true ! \
video/x-h264,profile=(string)high,level=(string)4.2 ! h264parse ! \
video/x-h264,stream-format=avc,alignment=au ! qtmux ! queue ! filesink location=output.mp4
```

(3) VP8 encoding example (dmabuf)

```
# gst-launch-1.0 v4l2src device=/dev/video0 num-buffers=300 io-mode=dmabuf no-resurrect-buf=true ! \
video/x-raw,format=NV12, framerate=60/1 ! \
omxvp8enc control-rate=2 target-bitrate=10485760 \
use-dmabuf=true ! \
video/x-vp8,level=(string)0 ! \
matroskamux ! queue ! filesink location=output.mkv
```

(4) VP8 encoding example (userptr)

```
# gst-launch-1.0 v4l2src device=/dev/video0 num-buffers=300 io-mode=userptr no-resurrect-buf=true ! \
video/x-raw,format=NV12, framerate=60/1 ! \
omxvp8enc control-rate=2 target-bitrate=10485760 no-copy=true ! \
video/x-vp8,level=(string)0 ! \
matroskamux ! queue ! filesink location=output.mkv
```

(*1) Notes: If the downstream element of v4l2src use frame rate value of caps, please set the appropriate frame rate to src pad of v4l2src.
In the above example, frame rate value is used for parameter of encoder element

4.10 Video crop and display examples

```
# gst-launch-1.0 filesrc location=file_1920_1080.mp4 ! qtdemux ! h264parse ! omxh264dec ! videocrop top=240
left=360 right=240 bottom=120 ! vspfilter ! video/x-raw,format=BGRA ! waylandsink (*)
```

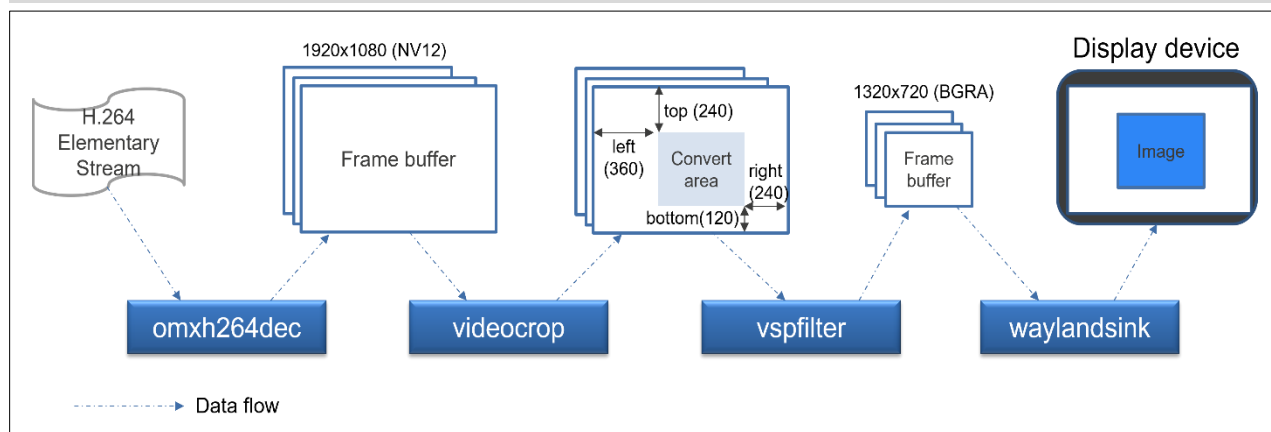


Figure 12 Data flow of video crop and display

*1: Without using vspfilter (scale or convert), cropping will be done in videocrop and it will take high CPU load.

5. Appendix

5.1 How to change the default mode in omx video decoder element

When we specify neither "no-copy" nor "use-dmabuf" option. The default mode of omx video decoder element is "use-dmabuf=true".

Here is how to change the default mode of omx video decoder element.

Please edit "gstomx.conf" to change the default mode.

In case of using no-copy mode as default, add the following definition to the "hacks".

```
hacks=use-no-copy-mode-as-default
```

In case of using use copy mode as default, add the following definition to the "hacks".

```
hacks=use-copy-mode-as-default
```

5.2 Explanations for default hacks

5.2.1 Default hacks of audio decoders (omxaaclddec, omxaacdec and omxmp3dec)

```
hacks=no-disable-outport
```

Explanations:

- *no-disable-outport*: don't allow disabling the outport when setting the format until the output format is known. It's necessary for audio decoders, video decoders and video encoders to work correctly.

For **omxwmadec**, there is additional hack:

- *skip-handle-codec-data*: Skip getting and sending codec data to OMX component. OMX WMADec doesn't require to receive it.

5.2.2 Default hacks of video decoders (omxh264dec, omxmpeg4videodec, omxvc1dec, omxh265dec, omxvp8dec and omxvp9dec)

```
hacks=no-disable-outport;default-pix-aspect-ratio;no-component-reconfigure
```

Explanations:

- *default-pix-aspect-ratio*: Keep pixel aspect ratio is 1/1 to keep display image as original (without scaling).
- *no-component-reconfigure*: Re-create OMX component if caps change. OMX component will be closed and re-opened when caps change. It is required when use buffer sharing with waylandsink (use-dmabuf=true (default) or no-copy=true)
For use cases which don't share buffer with waylandsink (use with vspfilter) and change state (from PLAYING to NULL and vice versa) continuously, recommend removing it to avoid influence of closing and re-opening OMX component between this hack and changing state.

5.2.3 Default hacks of video encoders (omxh264enc and omxvp8enc)

hacks=no-disable-outport;renesas-encmc-stride-align

Explanations:

- *renesas-encmc-stride-align*: Align input port stride (nStride) for 32 in case NV12 format and for 64 in case I420 format. It is required for Renesas OMX Video Encoder Components.

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REVISION HISTORY	Linux Interface Specification GStreamer User's Manual: Software
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Rev.	Date	Description	
		Page	Summary
0.1	Oct. 23, 2015	-	New version
0.2	Jan.14, 2016	9	- Update the description of the command line of "media-ctl"
0.3	Apr.1, 2016	1	- Update table of reference documents
		3-5	- Update the block diagrams
		5	- Add the block diagram connecting capture and display
		7-10	- Add the description of the elements information(omxmpeg4videodec, omxvc1dec, omxh265dec, omxaacdec, omxmp3dec, omxwmadec, omxh264enc, v4l2src)
		7	- Add "lossy-compress" property
		9	- Update the explanation of vspfilter element.
		11	- Add explanation about displayed location
		11,12	- In gst-launch command, insert queue in front of vpsfilter to divide the thread
		12-14	- Add playback examples(mpeg4vdec, vc1dec, h265dec, mp3dec, wmadec)
		15,16	- Add video capture examples
0.4	May.20, 2016	9	- Update vspfilter's explanation. - Add "input-io-mode" and "output-io-mode" property - Revise the property explanation of the default value of "devfile-input" and "devfile-output"
0.5	Aug.24, 2016	2-5	- Change name of chapter/section
		3-5	- Add VSPB in Figure as a related module of Weston
		8	- Add "use-dmabuf" property for omxh264enc - Revise property explanation of no-copy and use-dmabuf for omxh264enc
		9	- Add "use-subsurface" property for waylandsink - Revise explanation of waylandsink about input format - Add explanation of "io-mode" property for v4l2src
		11	- Remove vsp2/vspm driver from "modprobe" command line
		14	- Add Video framerate control example
		17	- Revise output size of NV16/NV12 format on "Capture from RCA"
		19	- Add example of NV12 format in "Video capture and display examples" section - Change from userptr to dmabuf io-mode of v4l2 in "Video capture and encoding example" section - Add example of "Capture and Scaling using vspfilter" - Fix typo on "H.264 encoding example"
0.6	Jan.13, 2017	6	- Update Gstreamer version 1.4.5 to 1.6.3
		9	- Add "no-resurrect-buf" property with version up of GStreamer
		10,13	- Add NV12 format to vspfilter's output
		11	- Change device file name of VSPi
		12	- Add example of Case of Down scaling without color format conversion
		18,20	- Change device file name of RCA from /dev/video1 to /dev/video5
		20	- Add "no-resurrect-buf" to capture and encoding pipeline
0.7	Mar. 15, 2017	21	- Add "framerate=60/1" to video capture and encoding pipeline
1.00	Jul.7, 2017	-	Update revision number

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1.10	Jan.12, 2018	3	- Add omxvp8dec and omxvp9dec to figure.
		5	- Add omxvp8enc to figure
		6	- Update Gstreamer version 1.6.3 to 1.12.2
		7-8	- Add the description of the elements information (omxvp8dec, omxvp9dec, omxvp8enc)
		10	- Add support format of vspfilter
		12	- Add explain about "setting VIN driver"
		15	- Add example of VP8 decoder and VP9 decoder
		17-18	- Change alsasink option according to specification change of Audio driver
1.20	Mar. 14, 2018	22	- Add example of VP8 encoder
		9	- Add "send-eos", "b-frames" and "ref-frames" property
		9	- Add explanation of "use-incaps-header" property
1.30	Apr. 11, 2018	10	- Add "suppress-interlace" property
1.40	Oct. 12, 2018	7-8	- Add "enable-crop" property
		10	- Add "num-alloc-buffer" property for debugging
2.00	Nov. 26, 2018	11	- Add "input color-range" property
		8	- Update the notice for "enable-crop" property
		9	- Add comment about use-dmabuf mode
2.10	April 06, 2021	18	- Add comment about warning message from WMA decoder.
		1	- 1.2.1: Add version of [5] Linux Interface Specification Device Driver Video Capture
		6	- 3.1: Table 5: Update license for GStreamer Base plugins and update new version (1.16.3) for plugins
		13	- 4.1: (4) Setting VIN driver: Update media-ctl setting as Linux Interface Specification Device Driver Video Capture v2.55
2.20	August 16, 2021	-	- Update revision number
		-	- Update AddressList
		2	- Add terminology for DRM and KMS.
		5	- Add figure for Video playback (kmssink)
		7	- Add "2.3.5 Video crop and display"
		9	- Add property "use-2ndhwip" for omxh264dec
		10	- Add note for "use-2ndhwip"
		12	- Table 9 Sink elements: Add "kmssink" element
		20	- Add "(11) Video playback with kmssink"
2.30	December 01, 2021	21	- Add "(12) Video playback with the second Hardware IP
		28	- Add "4.10 Video crop and display examples"
		-	- Update notice page
		8	- Table 5 GStreamer and GStreamer plug-in: Add kmssink information into gst-plugins-bad plug-in patch files
		12	- Table 9 Sink elements: Add information for standard property (driver-name, connector-id, force-modesetting)
		13	- Table 10 Src elements: Add deprecated information for no-resurrect-buf property.
2.30	December 01, 2021	20	- Add for note *1: "Please ensure mmngr was inserted and if there is no data in recoder.bin, please use with option "-e" (gst-launch -e) to ensure eos and query for drain." - Update for note *2: please use vspfilter to scale to support resolutions or use videocrop to crop to support resolution. Recommend using videocrop in BGRA format or can meet incorrect color display..
		29-30	- Add "5.2 Explanations for default hacks"

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