Video Overlay Interface

Also known as Framebuffer Overlay or Previewing.

Video overlay devices have the ability to genlock (TV-)video into the (VGA-)video signal of a graphics card, or to store captured images directly in video memory of a graphics card, typically with clipping. This can be considerable more efficient than capturing images and displaying them by other means. In the old days when only nuclear power plants needed cooling towers this used to be the only way to put live video into a window.

Video overlay devices are accessed through the same character special files as :ref:`video capture <capture>` devices.

> **System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master][Documentation][userspace-api][media][v4l]dev-overlay.rst, line 19); *backlink***
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> **Note**
>
> The default function of a `/dev/video` device is video capturing. The overlay function is only available after calling the :ref:`VIDIOC_S_FMT <VIDIOC_G_FMT>` ioctl.
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> > **System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master][Documentation][userspace-api][media][v4l]dev-overlay.rst, line 24); *backlink***
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The driver may support simultaneous overlay and capturing using the read/write and streaming I/O methods. If so, operation at the nominal frame rate of the video standard is not guaranteed. Frames may be directed away from overlay to capture, or one field may be used for overlay and the other for capture if the capture parameters permit this.

Applications should use different file descriptors for capturing and overlay. This must be supported by all drivers capable of simultaneous capturing and overlay. Optionally these drivers may also permit capturing and overlay with a single file descriptor for compatibility with V4L and earlier versions of V4L2. [1]

A common application of two file descriptors is the X11 :ref:`Xv/V4L <xvideo>` interface driver and a V4L2 application. While the X server controls video overlay, the application can take advantage of memory mapping and DMA.

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Querying Capabilities

Devices supporting the video overlay interface set the `V4L2_CAP_VIDEO_OVERLAY` flag in the `capabilities` field of struct :c:type:`v4l2_capability` returned by the :ref:`VIDIOC_QUERYCAP` ioctl. The overlay I/O method specified below must be supported. Tuners and audio inputs are optional.

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Supplemental Functions

Video overlay devices shall support :ref:`audio input <audio>`, :ref:`tuner`, :ref:`controls <control>`, :ref:`cropping and scaling <crop>` and :ref:`streaming parameter <streaming-par>` ioctls as needed. The :ref:`video input <video>` and :ref:`video standard <standard>` ioctls must be supported by all video overlay devices.

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Setup

Before overlay can commence applications must program the driver with frame buffer parameters, namely the address and size of the frame buffer and the image format, for example RGB 5:6:5. The :ref:`VIDIOC_G_FBUF <VIDIOC_G_FBUF>` and :ref:`VIDIOC_S_FBUF <VIDIOC_G_FBUF>` ioctls are available to get and set these parameters, respectively. The :ref:`VIDIOC_S_FBUF <VIDIOC_G_FBUF>` ioctl is privileged because it allows to set up DMA into physical memory, bypassing the memory protection mechanisms of the kernel. Only the superuser can change the frame buffer address and size. Users are not supposed to run TV applications as root or with SUID bit set. A small helper application with suitable privileges should query the graphics system and program the V4L2 driver at the appropriate time.

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Some devices add the video overlay to the output signal of the graphics card. In this case the frame buffer is not modified by the video device, and the frame buffer address and pixel format are not needed by the driver. The :ref:`VIDIOC_S_FBUF <VIDIOC_G_FBUF>` ioctl is not privileged. An application can check for this type of device by calling the :ref:`VIDIOC_G_FBUF <VIDIOC_G_FBUF>` ioctl.

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A driver may support any (or none) of five clipping/blending methods:

1. Chroma-keying displays the overlaid image only where pixels in the primary graphics surface assume a certain color.
2. A bitmap can be specified where each bit corresponds to a pixel in the overlaid image. When the bit is set, the corresponding video pixel is displayed, otherwise a pixel of the graphics surface.
3. A list of clipping rectangles can be specified. In these regions *no* video is displayed, so the graphics surface can be seen here.
4. The framebuffer has an alpha channel that can be used to clip or blend the framebuffer with the video.
5. A global alpha value can be specified to blend the framebuffer contents with video images.

When simultaneous capturing and overlay is supported and the hardware prohibits different image and frame buffer formats, the format requested first takes precedence. The attempt to capture (:ref:`VIDIOC_S_FMT <VIDIOC_G_FMT>`) or overlay (:ref:`VIDIOC_S_FBUF <VIDIOC_G_FBUF>`) may fail with an `EBUSY` error code or return accordingly modified parameters..

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master][Documentation][userspace-api][media][v4l]dev-overlay.rst, line 108); *backlink*

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Overlay Window

The overlaid image is determined by cropping and overlay window parameters. The former select an area of the video picture to capture, the latter how images are overlaid and clipped. Cropping initialization at minimum requires to reset the parameters to defaults. An example is given in :ref:`crop`.

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The overlay window is described by a struct :c:type:`v4l2_window`. It defines the size of the image, its position over the graphics

surface and the clipping to be applied. To get the current parameters applications set the `type` field of a struct :c:type:`v4l2_format` to `V4L2_BUF_TYPE_VIDEO_OVERLAY` and call the :ref:`VIDIOC_G_FMT <VIDIOC_G_FMT>` ioctl. The driver fills the struct :c:type:`v4l2_window` substructure named `win`. It is not possible to retrieve a previously programmed clipping list or bitmap.

System Message: ERROR/3 (`D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master][Documentation][userspace-api][media][v4l]dev-overlay.rst`, line 125); *backlink*

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To program the overlay window applications set the `type` field of a struct :c:type:`v4l2_format` to `V4L2_BUF_TYPE_VIDEO_OVERLAY`, initialize the `win` substructure and call the :ref:`VIDIOC_S_FMT <VIDIOC_G_FMT>` ioctl. The driver adjusts the parameters against hardware limits and returns the actual parameters as :ref:`VIDIOC_G_FMT <VIDIOC_G_FMT>` does. Like :ref:`VIDIOC_S_FMT <VIDIOC_G_FMT>`, the :ref:`VIDIOC_TRY_FMT <VIDIOC_G_FMT>` ioctl can be used to learn about driver capabilities without actually changing driver state. Unlike :ref:`VIDIOC_S_FMT <VIDIOC_G_FMT>` this also works after the overlay has been enabled.

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The scaling factor of the overlaid image is implied by the width and height given in struct :c:type:`v4l2_window` and the size of the cropping rectangle. For more information see :ref:`crop`.

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When simultaneous capturing and overlay is supported and the hardware prohibits different image and window sizes, the size requested first takes precedence. The attempt to capture or overlay as well (:ref:`VIDIOC_S_FMT <VIDIOC_G_FMT>`) may fail with an `EBUSY` error code or return accordingly modified parameters.

System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master][Documentation][userspace-api][media][v4l]dev-overlay.rst, line 149); *backlink*

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Unknown directive type "c:type".

```
.. c:type:: v4l2_window
```

struct v4l2_window

`struct v4l2_rect w`

Size and position of the window relative to the top, left corner of the frame buffer defined with :ref:`VIDIOC_S_FBUF <VIDIOC_G_FBUF>`. The window can extend the frame buffer width and height, the `x` and `y` coordinates can be negative, and it can lie completely outside the frame buffer. The driver clips the window accordingly, or if that is not possible, modifies its size and/or position.

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`enum v4l2_field field`

Applications set this field to determine which video field shall be overlaid, typically one of `V4L2_FIELD_ANY` (0), `V4L2_FIELD_TOP`, `V4L2_FIELD_BOTTOM` or `V4L2_FIELD_INTERLACED`. Drivers may have to choose a different field order and return the actual setting here.

`__u32 chromakey`

When chroma-keying has been negotiated with :ref:`VIDIOC_S_FBUF <VIDIOC_G_FBUF>` applications set this field to the desired pixel value for the chroma key. The format is the same as the pixel format of the framebuffer (struct :c:type:`v4l2_framebuffer` `fmt.pixelformat` field), with bytes in host order. E. g. for :ref:`V4L2_PIX_FMT_BGR24 <V4L2-PIX-FMT-BGR32>` the value should be 0xRRGGBB on a little endian, 0xBBGGRR on a big endian host.

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`struct v4l2_clip * clips`

When chroma-keying has *not* been negotiated and :ref:`VIDIOC_G_FBUF <VIDIOC_G_FBUF>` indicated this capability, applications can set this field to point to an array of clipping rectangles.

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Like the window coordinates w, clipping rectangles are defined relative to the top, left corner of the frame buffer. However clipping rectangles must not extend the frame buffer width and height, and they must not overlap. If possible applications should merge adjacent rectangles. Whether this must create x-y or y-x bands, or the order of rectangles, is not defined. When clip lists are not supported the driver ignores this field. Its contents after calling :ref:`VIDIOC_S_FMT <VIDIOC_G_FMT>` are undefined.

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`__u32 clipcount`

When the application set the `clips` field, this field must contain the number of clipping rectangles in the list. When clip lists are not supported the driver ignores this field, its contents after calling :ref:`VIDIOC_S_FMT <VIDIOC_G_FMT>` are undefined. When clip lists are supported but no clipping is desired this field must be set to zero.

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`void * bitmap`

When chroma-keying has *not* been negotiated and :ref:`VIDIOC_G_FBUF <VIDIOC_G_FBUF>` indicated this capability, applications can set this field to point to a clipping bit mask.

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It must be of the same size as the window, `w.width` and `w.height`. Each bit corresponds to a pixel in the overlaid image, which is displayed only when the bit is *set*. Pixel coordinates translate to bits like:

```
((__u8 *) bitmap)[w.width * y + x / 8] & (1 << (x & 7))
```

where 0 â‰¤ x < w.width and 0 â‰¤ y < w.height. [2]

When a clipping bit mask is not supported the driver ignores this field, its contents after calling :ref:`VIDIOC_S_FMT <VIDIOC_G_FMT>` are undefined. When a bit mask is supported but no clipping is desired this field must be set to NULL.

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Applications need not create a clip list or bit mask. When they pass both, or despite negotiating chroma-keying, the results are undefined. Regardless of the chosen method, the clipping abilities of the hardware may be limited in quantity or quality. The results when these limits are exceeded are undefined. [3]

`__u8 global_alpha`

The global alpha value used to blend the framebuffer with video images, if global alpha blending has been negotiated (V4L2_FBUF_FLAG_GLOBAL_ALPHA, see :ref:`VIDIOC_S_FBUF <VIDIOC_G_FBUF>`, :ref:`framebuffer-flags`).

> **System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master][Documentation][userspace-api][media][v4l]dev-overlay.rst, line 239); *backlink***
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> **Note**
>
> This field was added in Linux 2.6.23, extending the structure. However the :ref:`VIDIOC_[G|S|TRY]_FMT <VIDIOC_G_FMT>` ioctls, which take a pointer to a :c:type:`v4l2_format` parent structure with padding bytes at the end, are not affected.
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> > **System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master][Documentation][userspace-api][media][v4l]dev-overlay.rst, line 247); *backlink***
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> > **System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\userspace-api\media\v4l\[linux-master][Documentation][userspace-api][media][v4l]dev-overlay.rst, line 247); *backlink***
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>
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>
> ```
> .. c:type:: v4l2_clip
> ```

struct v4l2_clip [4]

`struct v4l2_rect c`

Coordinates of the clipping rectangle, relative to the top, left corner of the frame buffer. Only window pixels *outside* all clipping rectangles are displayed.

`struct v4l2_clip * next`

Pointer to the next clipping rectangle, `NULL` when this is the last rectangle. Drivers ignore this field, it cannot be used to pass a linked list of clipping rectangles.

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```
.. c:type:: v4l2_rect
```

struct v4l2_rect

`__s32 left`
: Horizontal offset of the top, left corner of the rectangle, in pixels.

`__s32 top`
: Vertical offset of the top, left corner of the rectangle, in pixels. Offsets increase to the right and down.

`__u32 width`
: Width of the rectangle, in pixels.

`__u32 height`
: Height of the rectangle, in pixels.

Enabling Overlay

To start or stop the frame buffer overlay applications call the :ref:`VIDIOC_OVERLAY` ioctl.

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[1] In the opinion of the designers of this API, no driver writer taking the efforts to support simultaneous capturing and overlay will restrict this ability by requiring a single file descriptor, as in V4L and earlier versions of V4L2. Making this optional means applications depending on two file descriptors need backup routines to be compatible with all drivers, which is considerable more work than using two fds in applications which do not. Also two fd's fit the general concept of one file descriptor for each logical stream. Hence as a complexity trade-off drivers *must* support two file descriptors and *may* support single fd operation.

[2] Should we require `w.width` to be a multiple of eight?

[3] When the image is written into frame buffer memory it will be undesirable if the driver clips out less pixels than expected, because the application and graphics system are not aware these regions need to be refreshed. The driver should clip out more pixels or not write the image at all.

[4] The X Window system defines "regions" which are vectors of `struct BoxRec { short x1, y1, x2, y2; }` with `width = x2 - x1` and `height = y2 - y1`, so one cannot pass X11 clip lists directly.