



COLLABORA

Shifting Media app development into high gear

Using virtual drivers to speed up development

Open First

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Summary

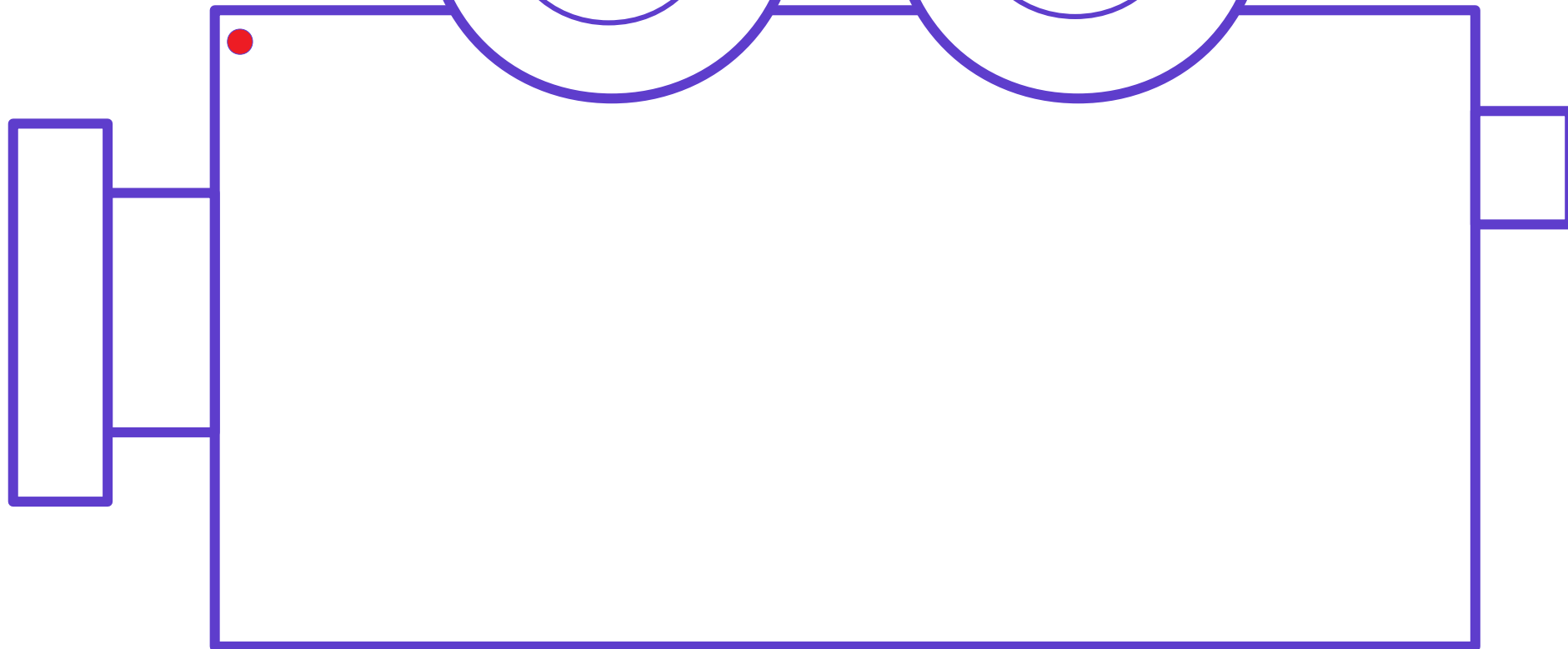
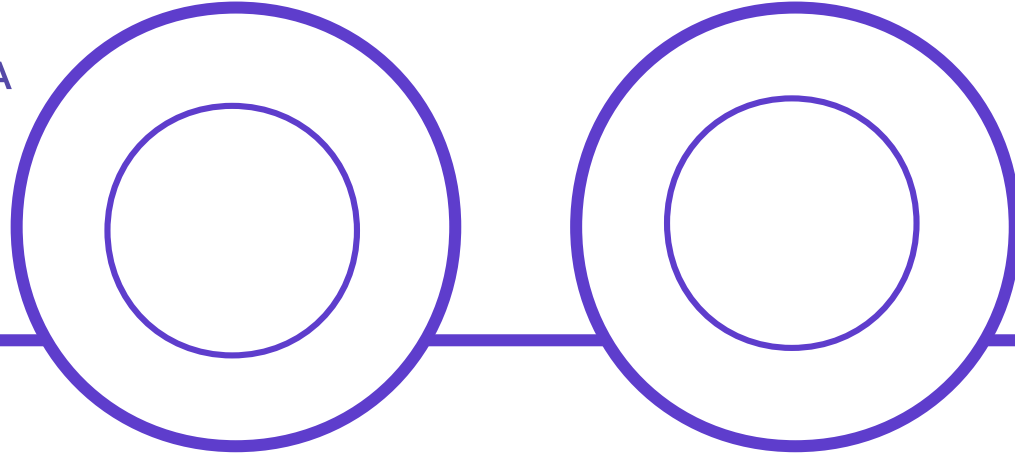
- Classic V4L2 API → Vivid Driver
- Media API (extension) → Vimc Driver

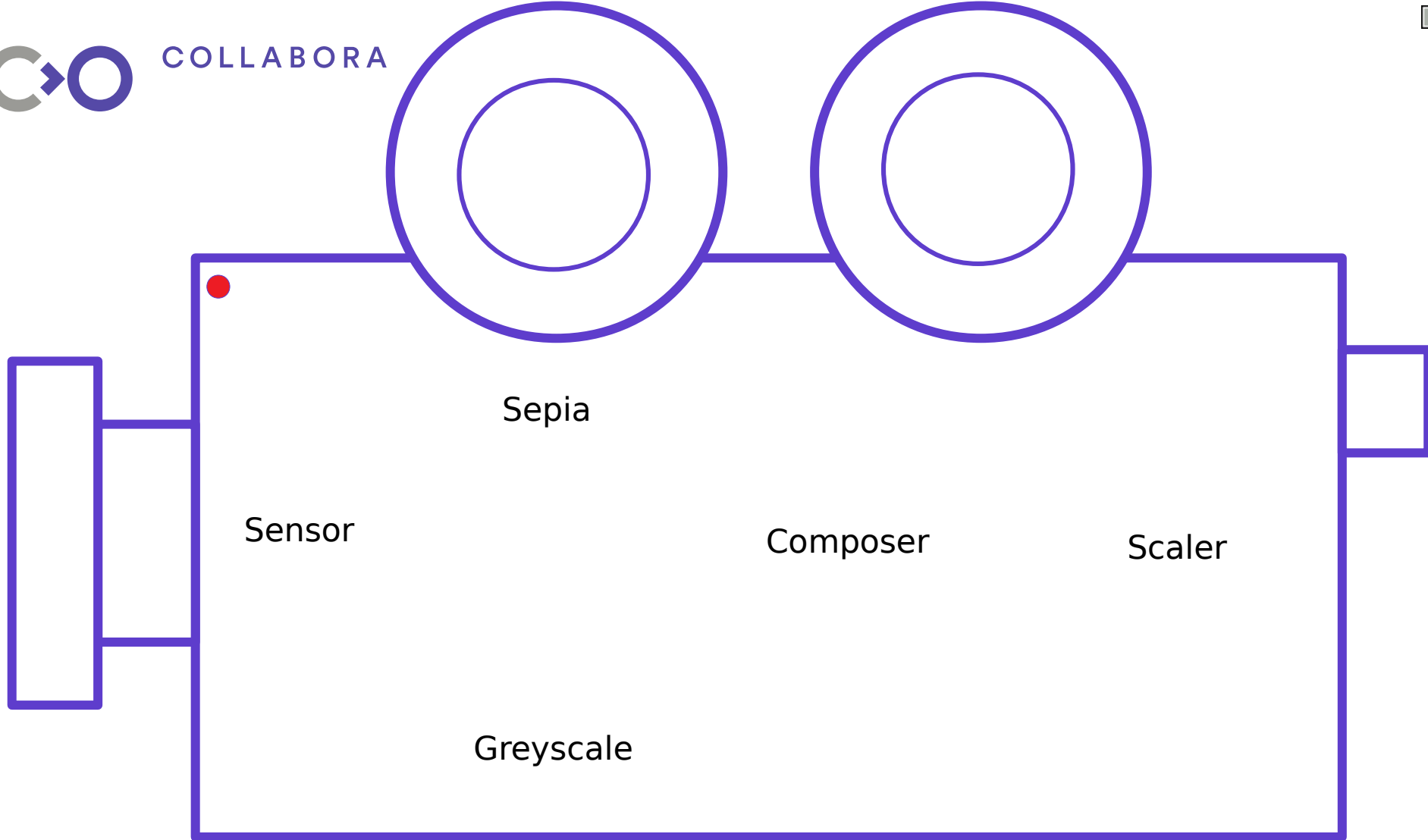
- Vimc:
 - Submodules
 - Current state
 - Configfs API
 - Future work



Summary

- **Classic V4L2 API** → **Vivid Driver**
- Media API (extension) → Vimc Driver
- Vimc:
 - Submodules
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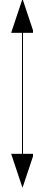






User space

APP



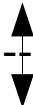
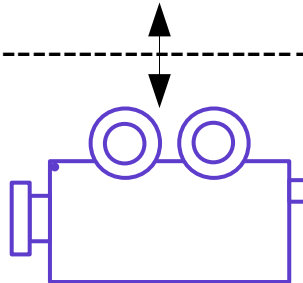
----- /dev/video* -----

Kernel space

Driver



Physical device





User space

APP

Read/Write/MMAP

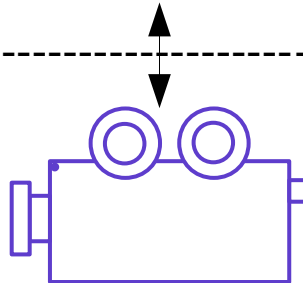
/dev/video*

Kernel space

Driver

Video stream

Physical device





User space

APP

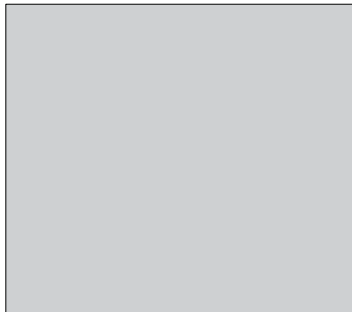
Read/Write/MMAP

IOCTLs

----- /dev/video* -----

Driver

Video stream



General configs

- * Img fmt
- * Buffers
- * Video std
- * Frame rate
- .
- .

Standard Controls

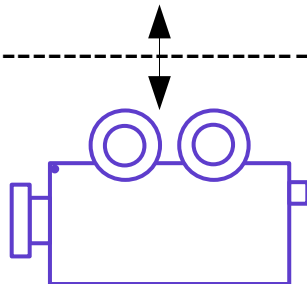
- * Contrast
- * Brightness
- * Gamma
- .
- .
- .

Custom Controls

- * DRV DEF 1
- * DRV DEF 2
- * DRV DEF 3
- .
- .
- .

Kernel space

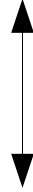
Physical device





User space

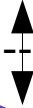
APP



----- /dev/video* -----

Kernel space

Driver



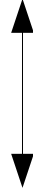
Physical device





User space

APP

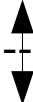


----- /dev/video* -----

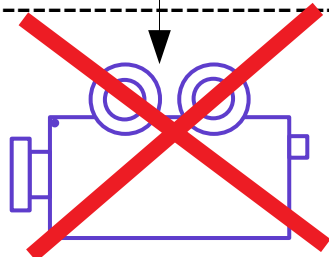
Kernel space



Driver



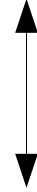
Physical device





User space

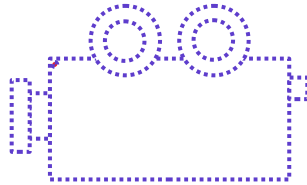
APP



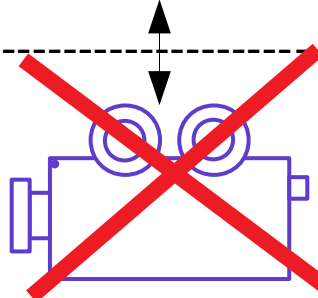
----- /dev/video* -----

Kernel space

The Virtual Video Test Driver (VIVID)

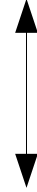


Physical device





APP

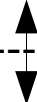
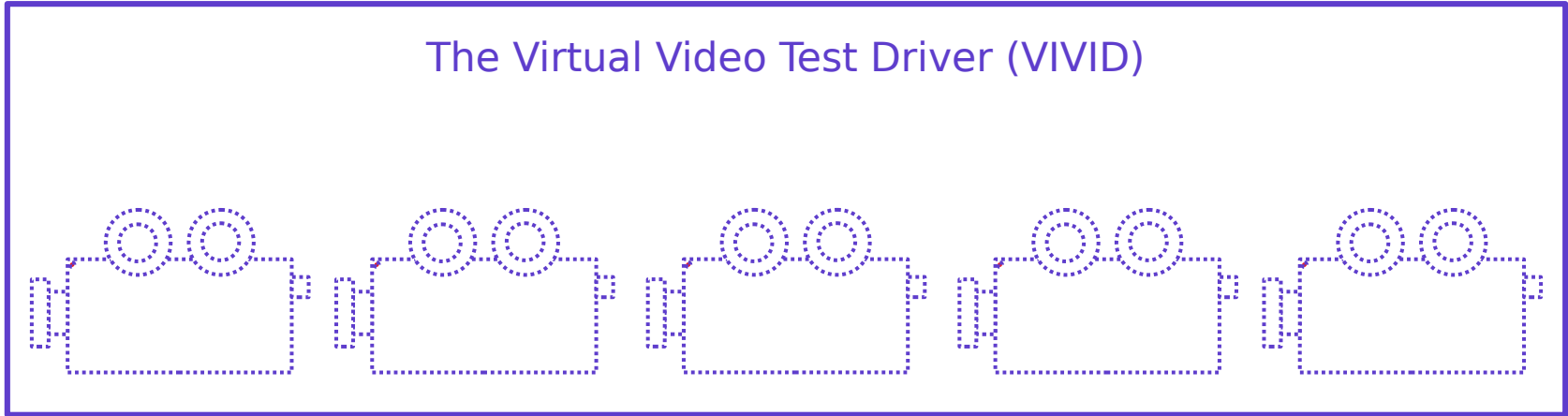


User space

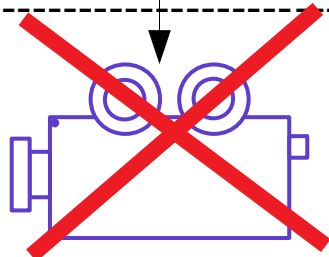
----- /dev/video* -----

The Virtual Video Test Driver (VIVID)

Kernel space



Physical device



Vivid driver

V4L2 Test Bench

File Capture Help

General Settings User Controls Digital Video Controls Vivid Controls

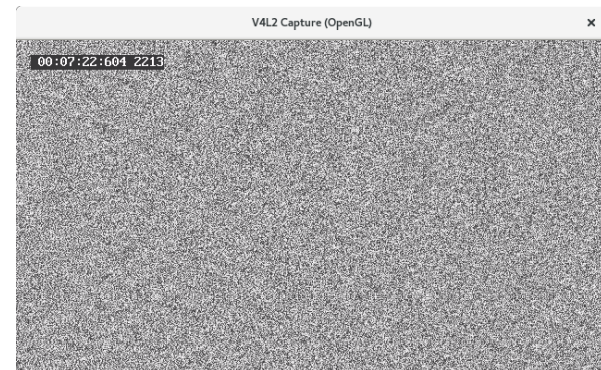
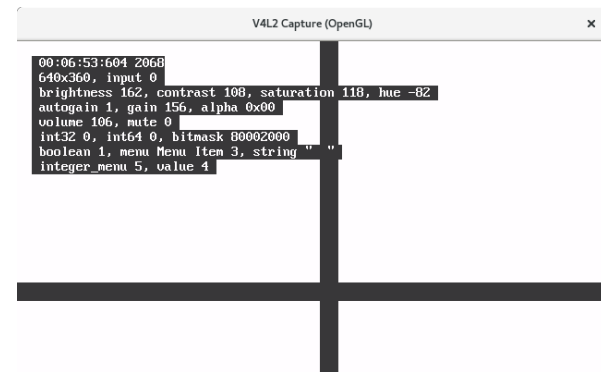
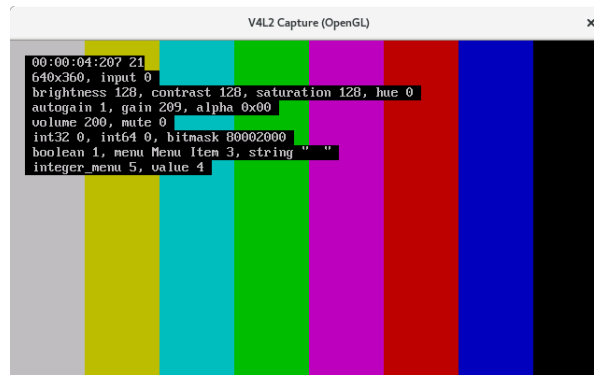
Vivid Controls

Test Pattern: 75% Colorbar	Enable Capture Composing: <input checked="" type="checkbox"/>
OSD Text Mode: All	Enable Capture Scaler: <input checked="" type="checkbox"/>
Horizontal Movement: No Movement	Loop Video: <input type="checkbox"/>
Vertical Movement: No Movement	Wrap Sequence Number: <input type="checkbox"/>
Show Border: <input type="checkbox"/>	Wrap Timestamp: <input type="checkbox"/>
Show Square: <input type="checkbox"/>	Maximum EDID Blocks: 2
Insert SAV Code in Image: <input type="checkbox"/>	Fill Percentage of Frame: 100
Insert EAV Code in Image: <input type="checkbox"/>	Reduced Framerate: <input type="checkbox"/>
Sensor Flipped Horizontally: <input type="checkbox"/>	HSV Encoding: Hue 0-179
Sensor Flipped Vertically: <input type="checkbox"/>	Standard Signal Mode: Current Standard
Standard Aspect Ratio: 4x3	Standard: NTSC-M
DV Timings Aspect Ratio: Source Width x Height	DV Timings Signal Mode: Current DV Timings
Timestamp Source: End of Frame	DV Timings: 640x480p59
Colorspace: sRGB	Percentage of Dropped Buffers: 0
Transfer Function: Default	Disconnect: <input type="button" value="↔"/>
YCbCr Encoding: Default	Inject V4L2_BUF_FLAG_ERROR: <input type="button" value="↔"/>
Quantization: Default	Inject VIDIOC_REQBUFS Error: <input type="button" value="↔"/>
Limited RGB Range (16-235): <input type="checkbox"/>	Inject VIDIOC_QBUF Error: <input type="button" value="↔"/>
Apply Alpha To Red Only: <input type="checkbox"/>	Inject VIDIOC_STREAMON Error: <input type="button" value="↔"/>
Enable Capture Cropping: <input checked="" type="checkbox"/>	Inject Fatal Streaming Error: <input type="button" value="↔"/>

Update on change

Set Defaults Refresh Update

Frame: 41 Fps: 5.00 Scale Factors: 1x1 SeqNr: 40



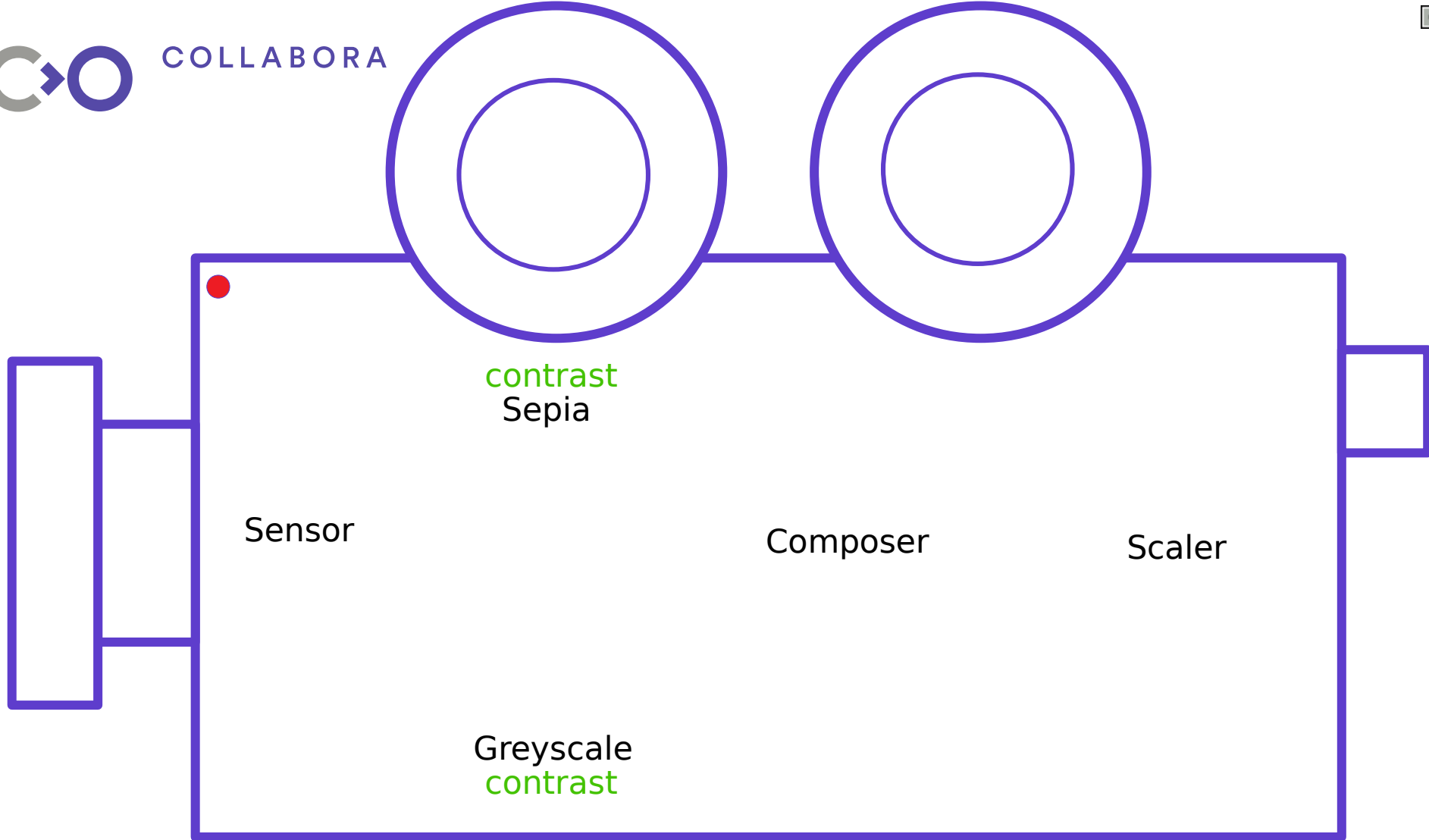
Summary

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Media API Motivation

- Embedded systems: great variety of devices
- Hardware complexity
- Similar configuration for different entities





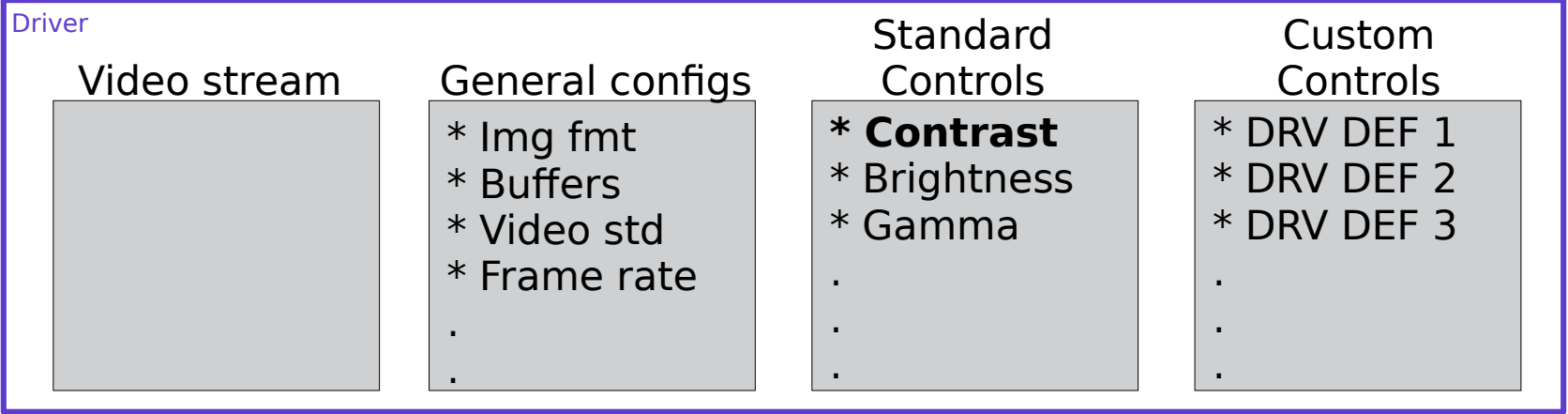
User space

APP

Read/Write/MMAP

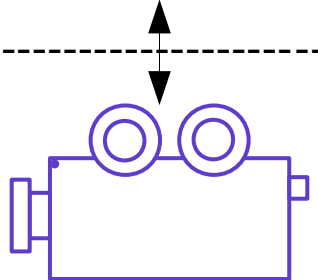
IOCTLs

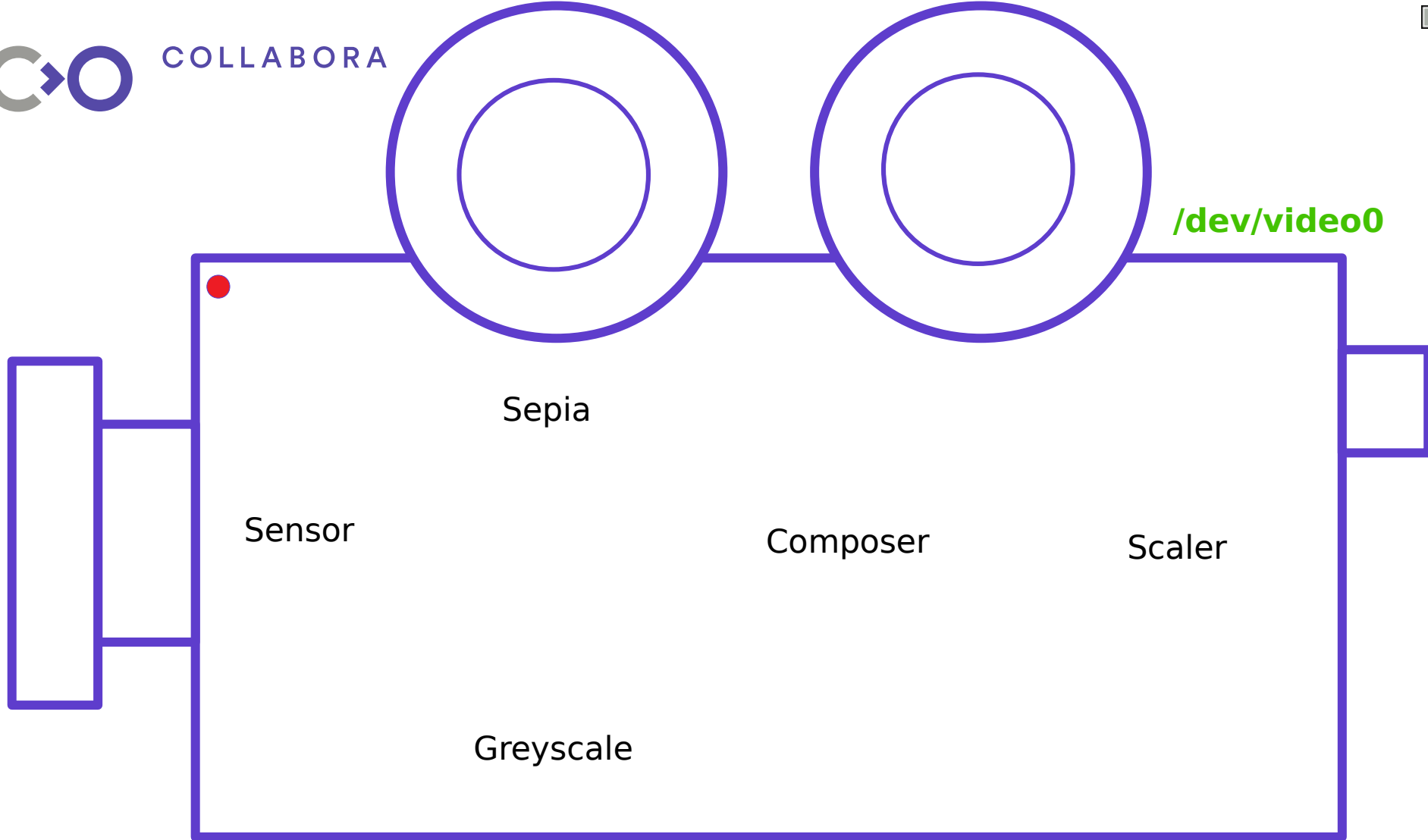
----- /dev/video* -----

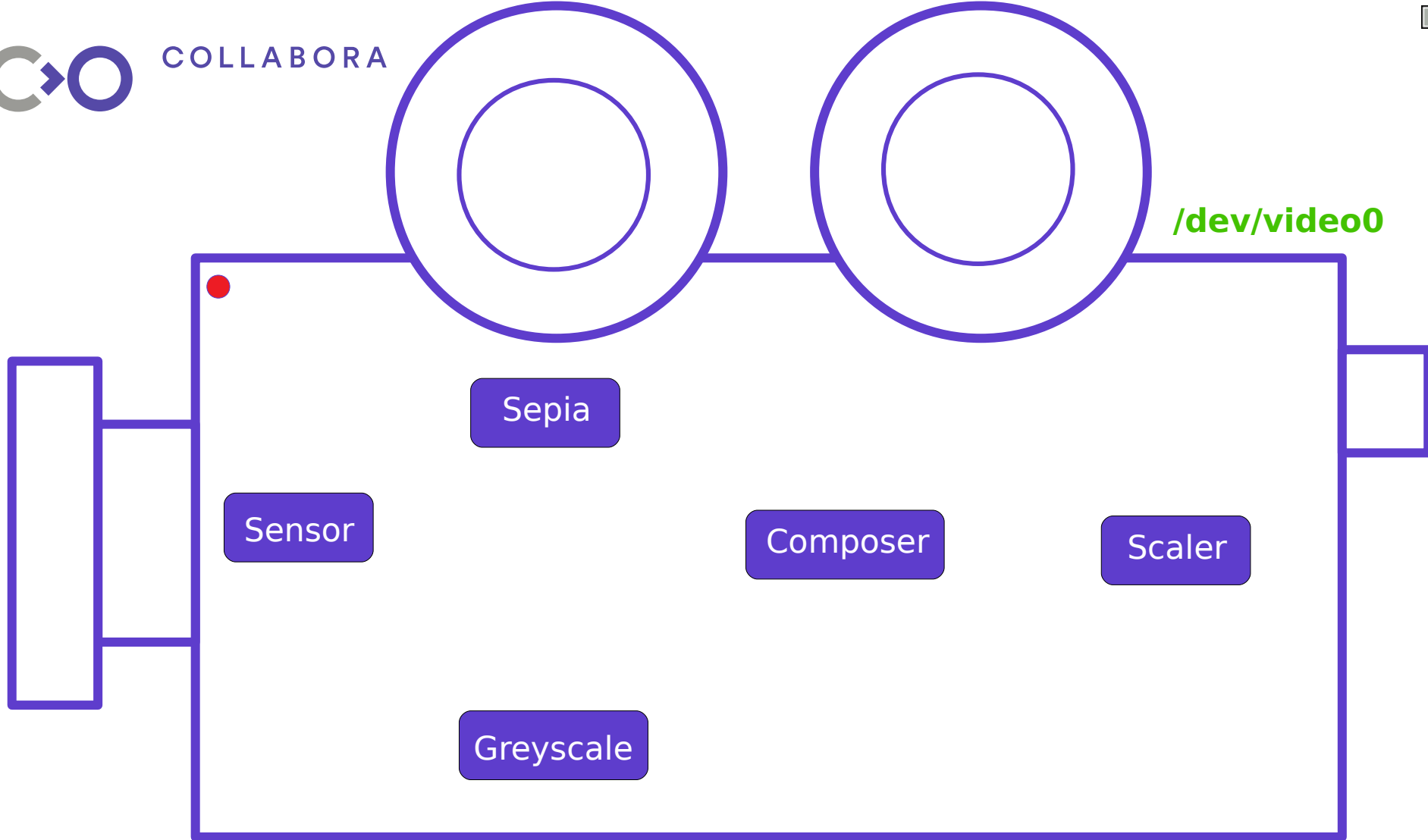


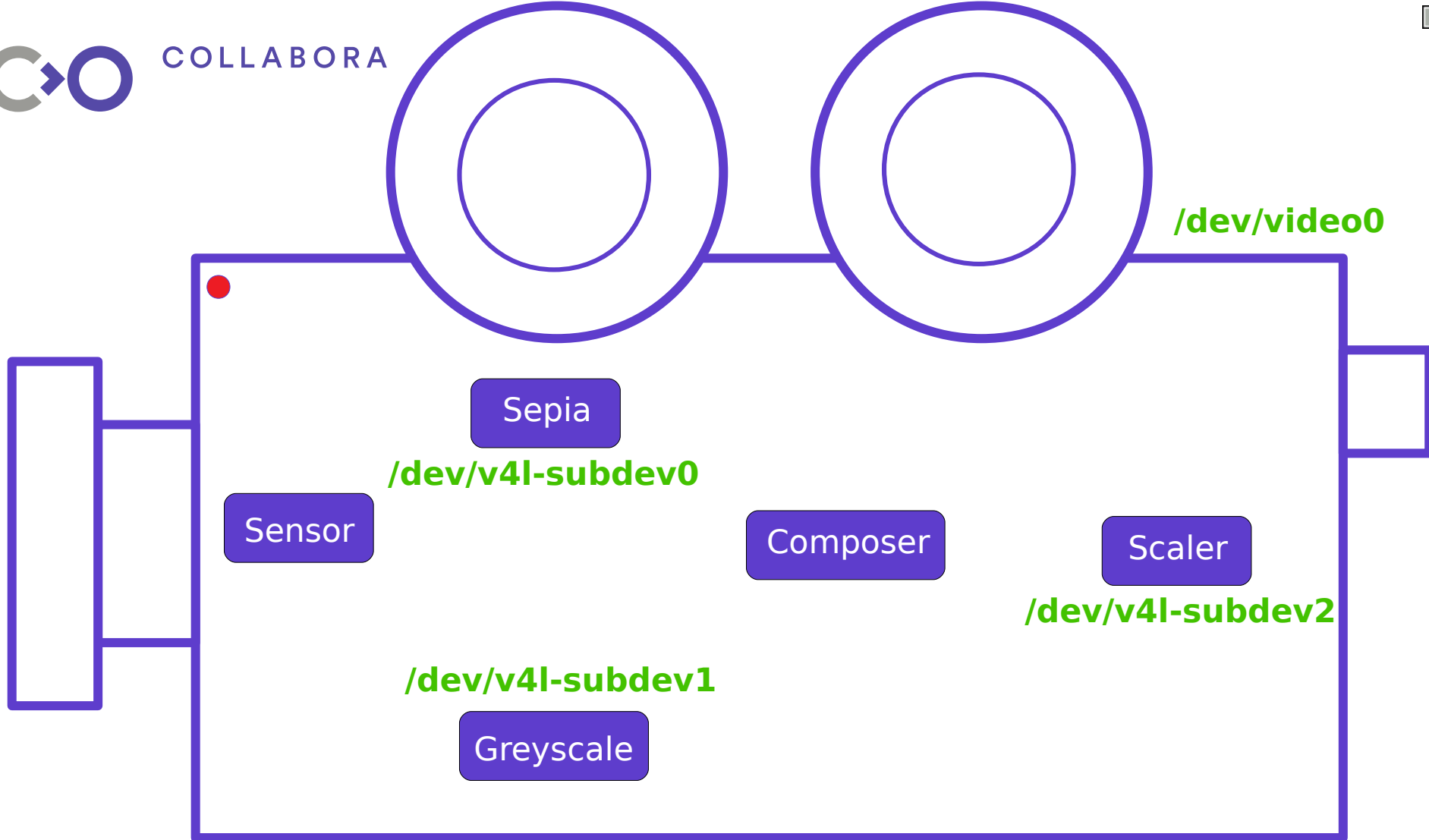
Kernel space

Physical device



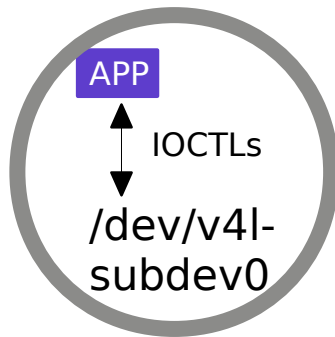
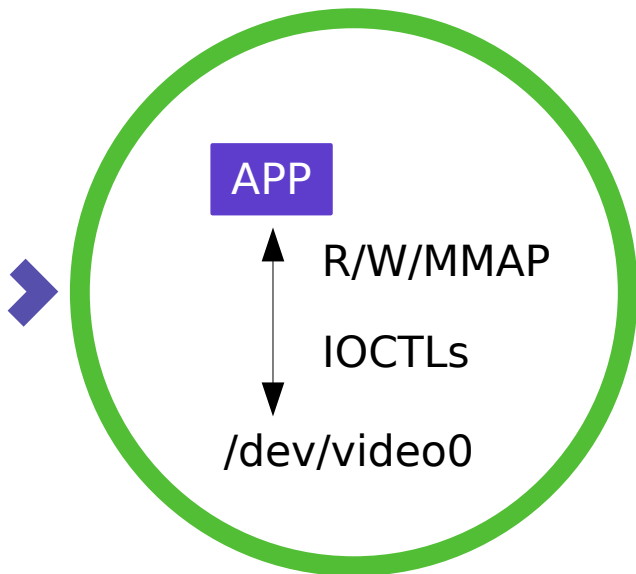




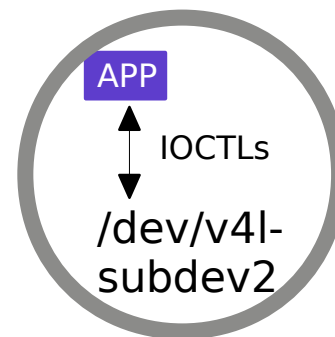




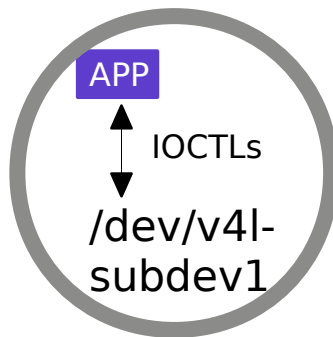
Subdev API



contrast
Sepia



Scaler

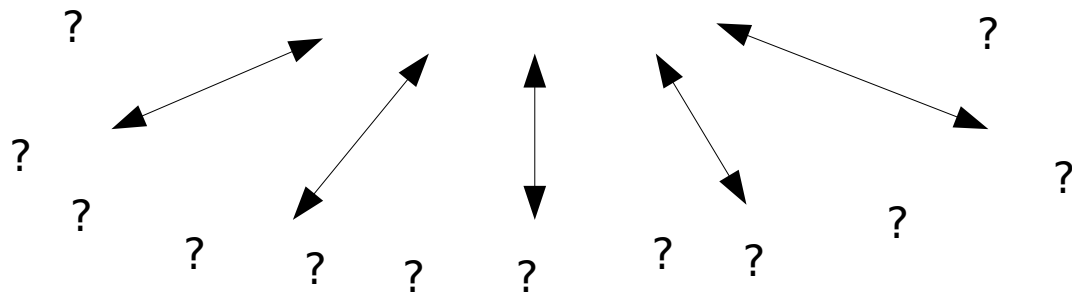


contrast
Greyscale



What is part of the device? What is the topology?

APP



/dev/v4l-subdev0

/dev/v4l-subdev98

/dev/v4l-subdev11

/dev/v4l-subdev14

/dev/video0

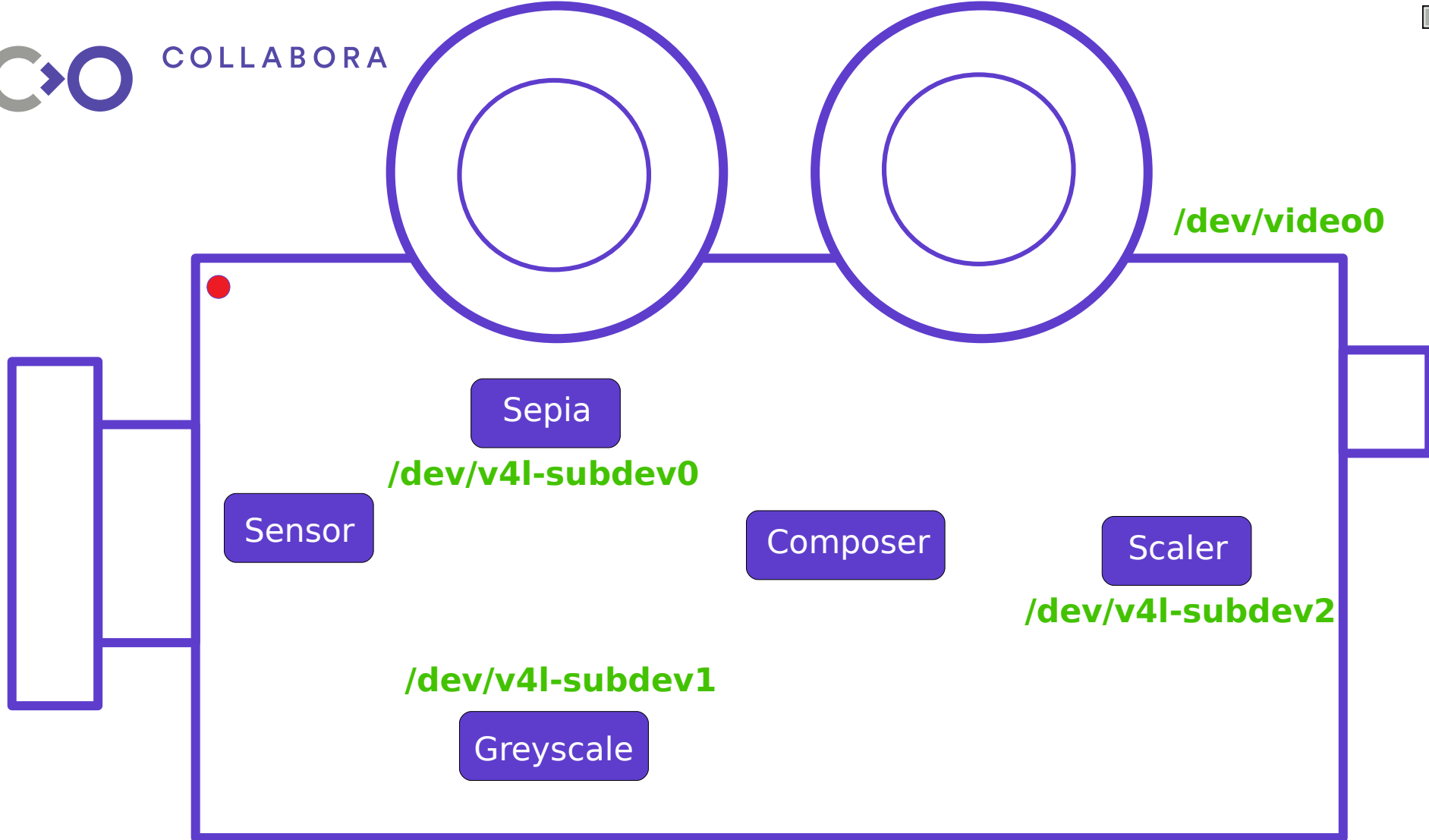
/dev/v4l-subdev6

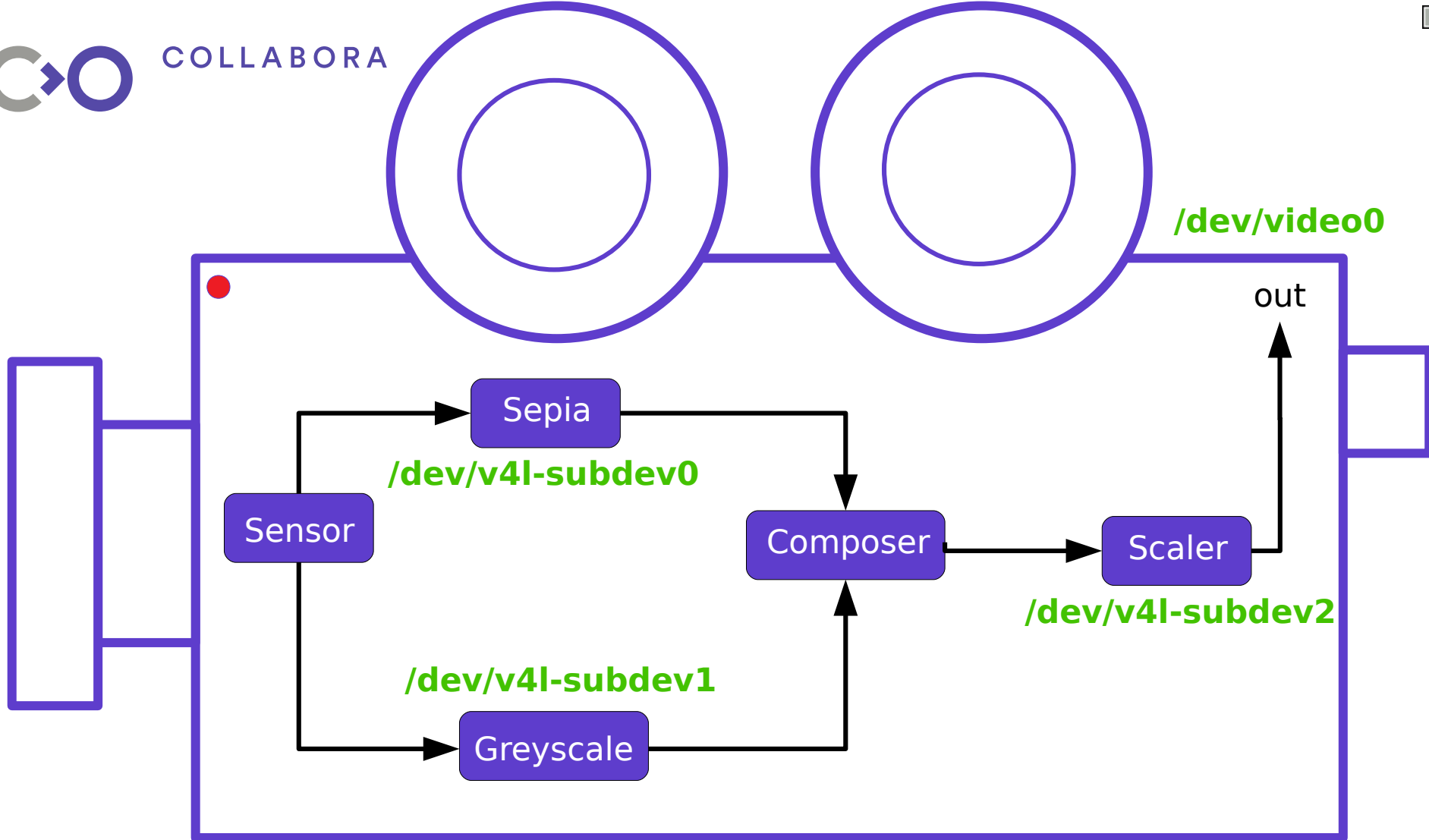
/dev/video2

/dev/video42

/dev/v4l-subdev21

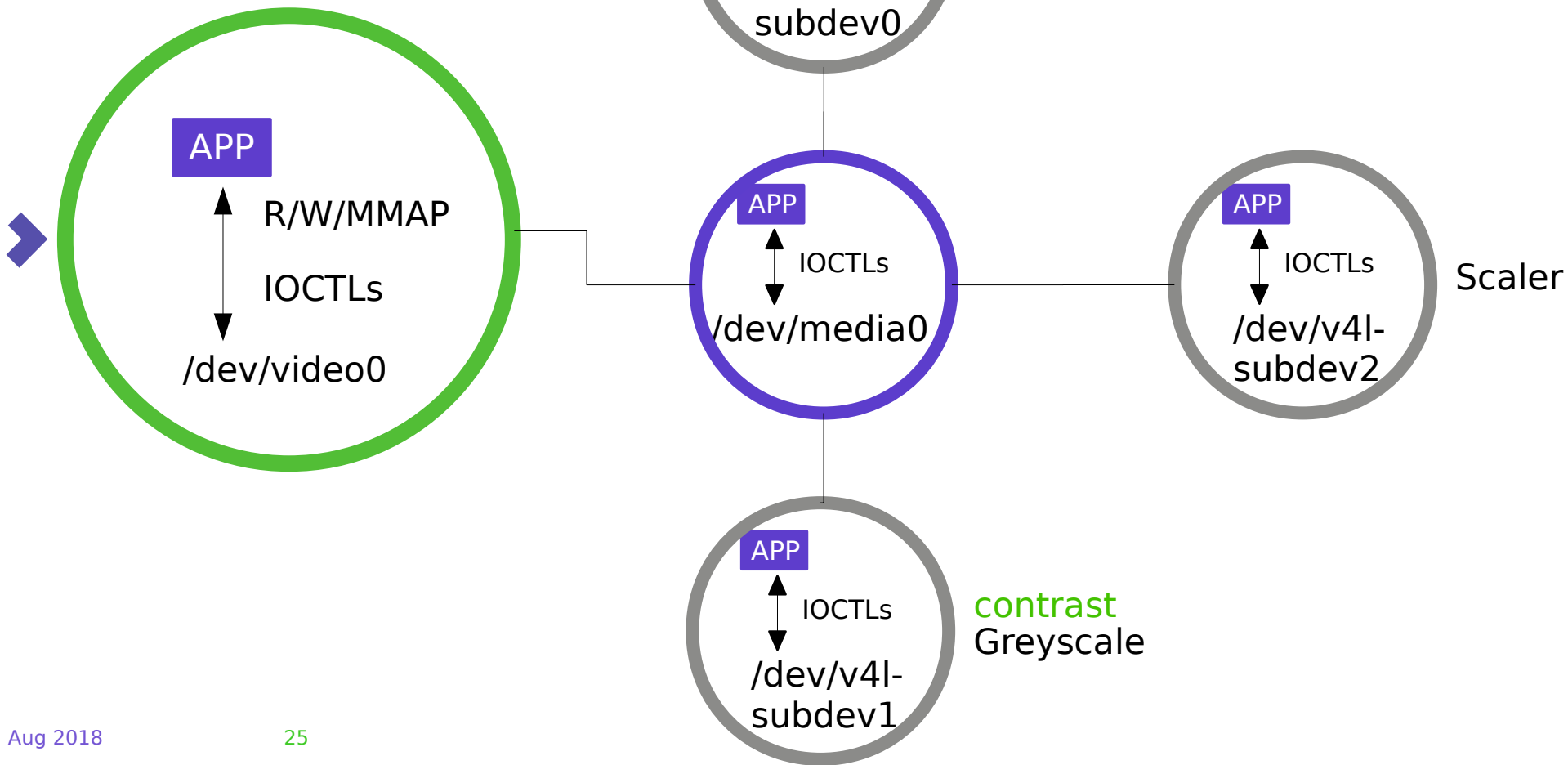
/dev/v4l-subdev31

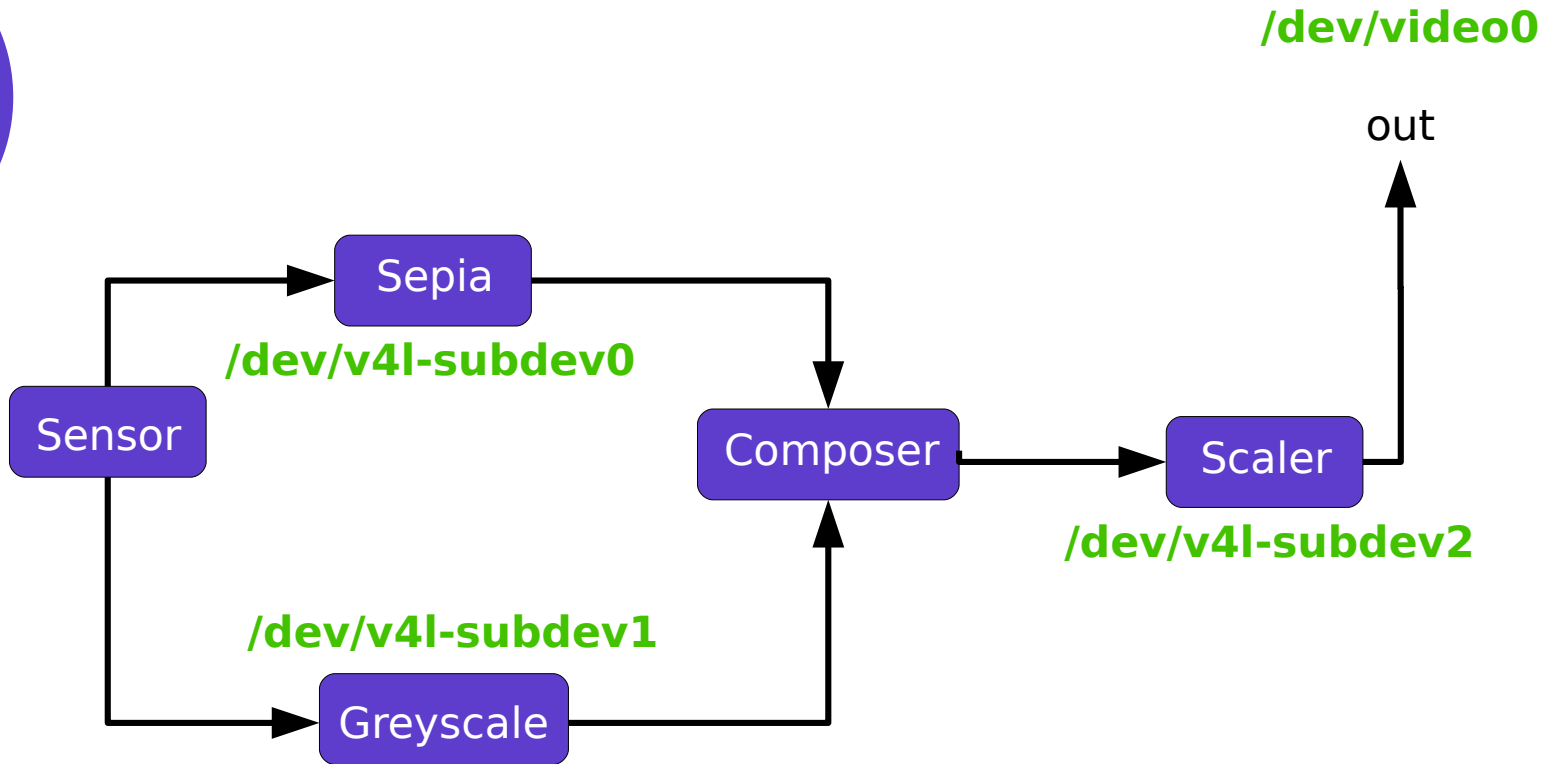
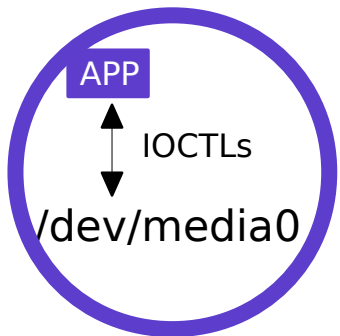


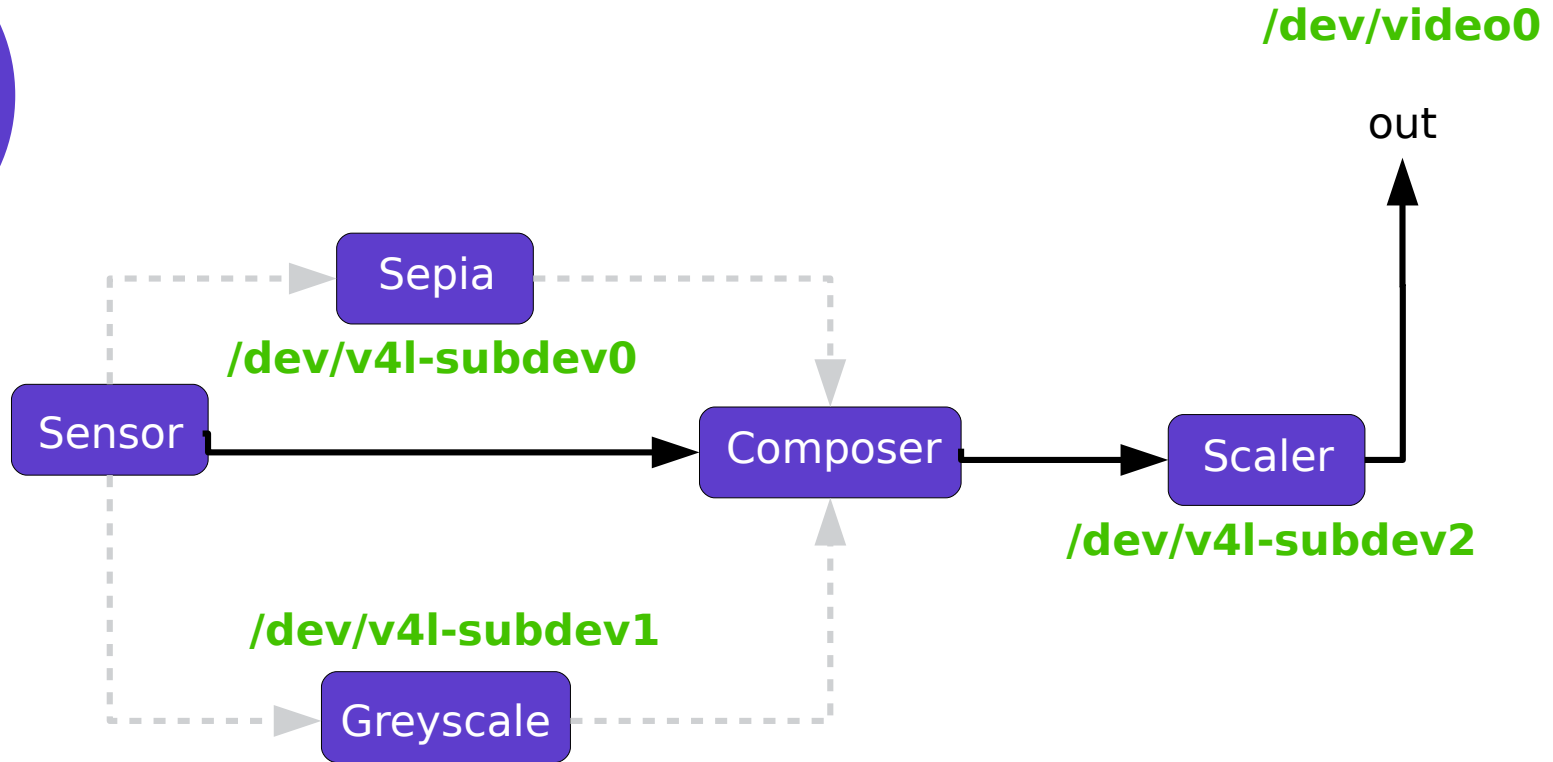
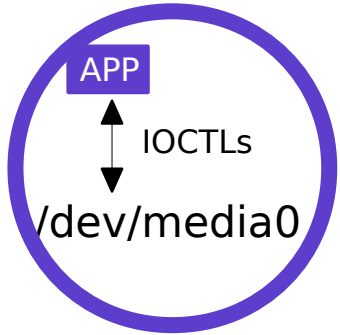




Media API



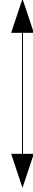






User space

APP



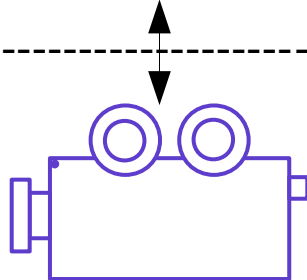
----- /dev/media* -----

Kernel space

Driver



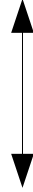
Physical device





User space

APP

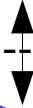


----- /dev/media* -----

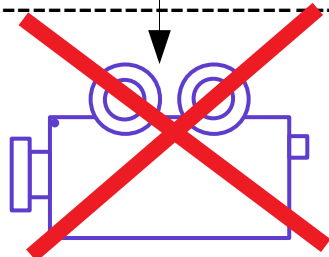
Kernel space



Driver



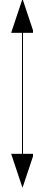
Physical device





User space

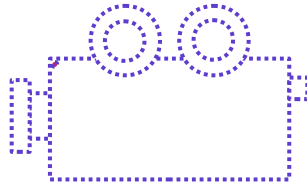
APP



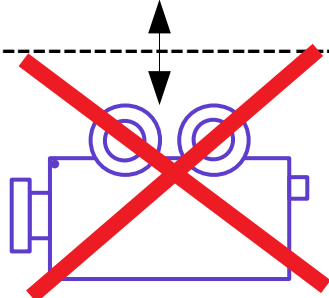
----- /dev/media* -----

Kernel space

The Virtual Media Controller Driver (VIMC)



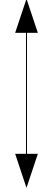
Physical device





User space

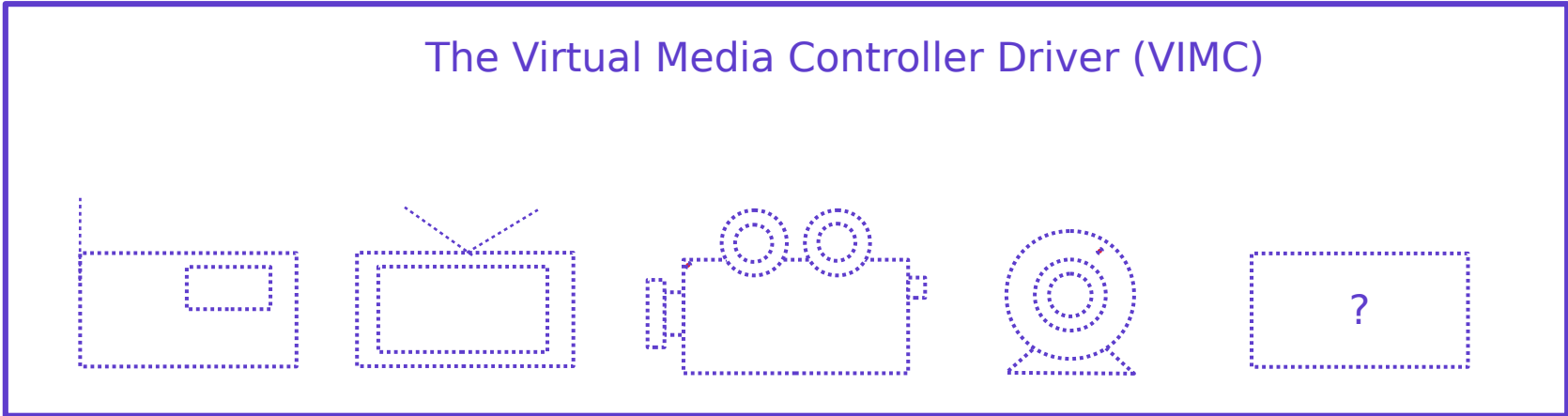
APP



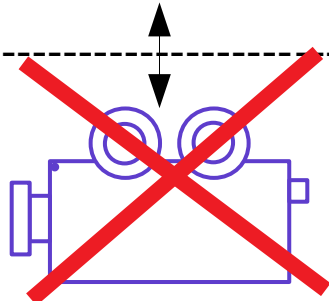
----- /dev/media* -----

Kernel space

The Virtual Media Controller Driver (VIMC)



Physical device





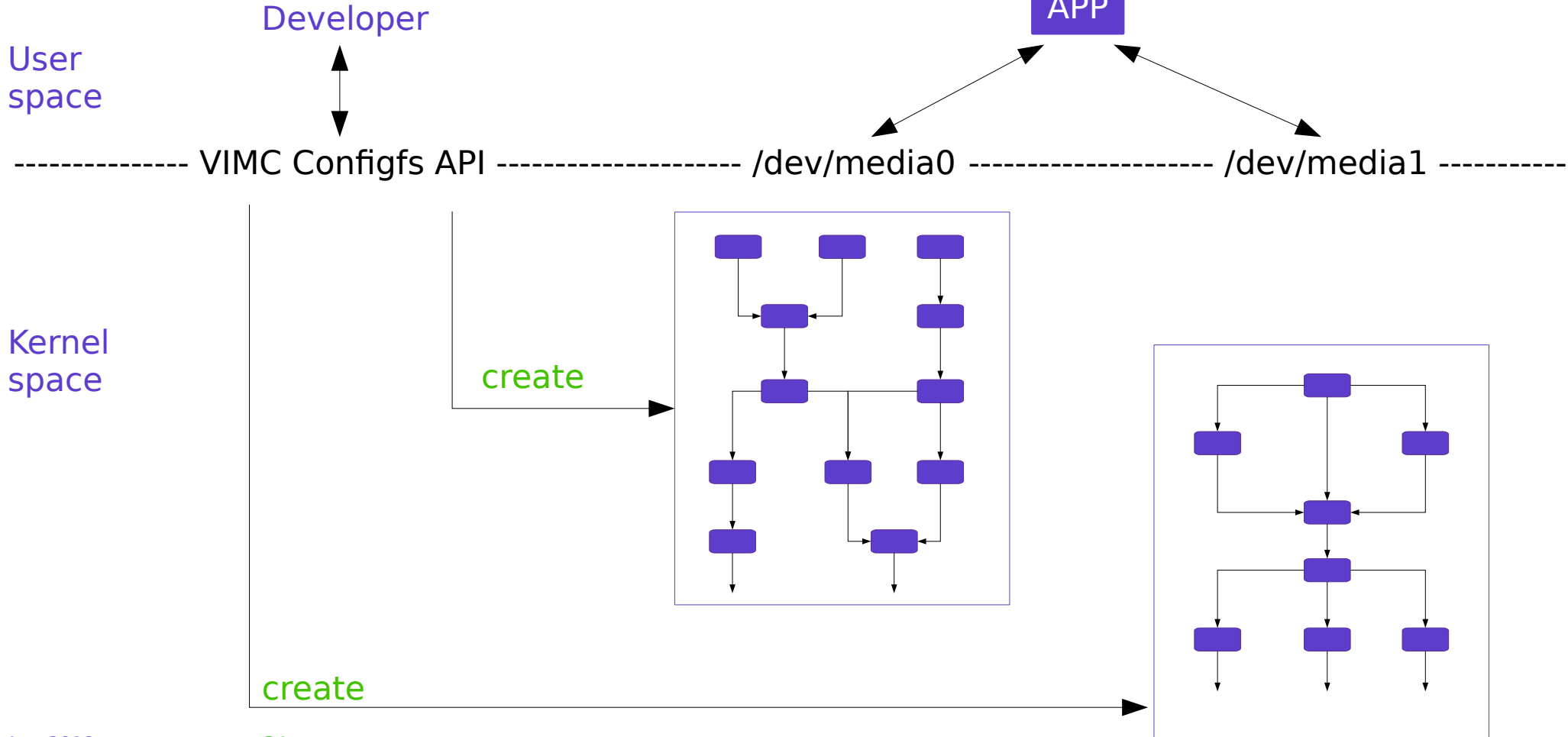
Other use cases:

- Board bring-up
- Tests on a PC instead of an embedded device
- Test application in different hardwares
 - e.g. Gstreamer
- Loop back device
 - Adding layers of effects
 - Test streams



Summary

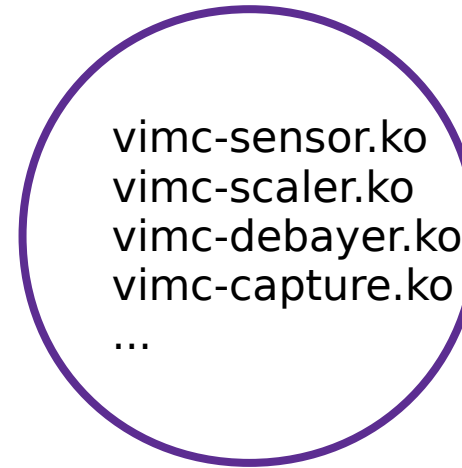
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APP Developer

Emulate different topologies to test the app in several scenarios



Standard



Manufacturer



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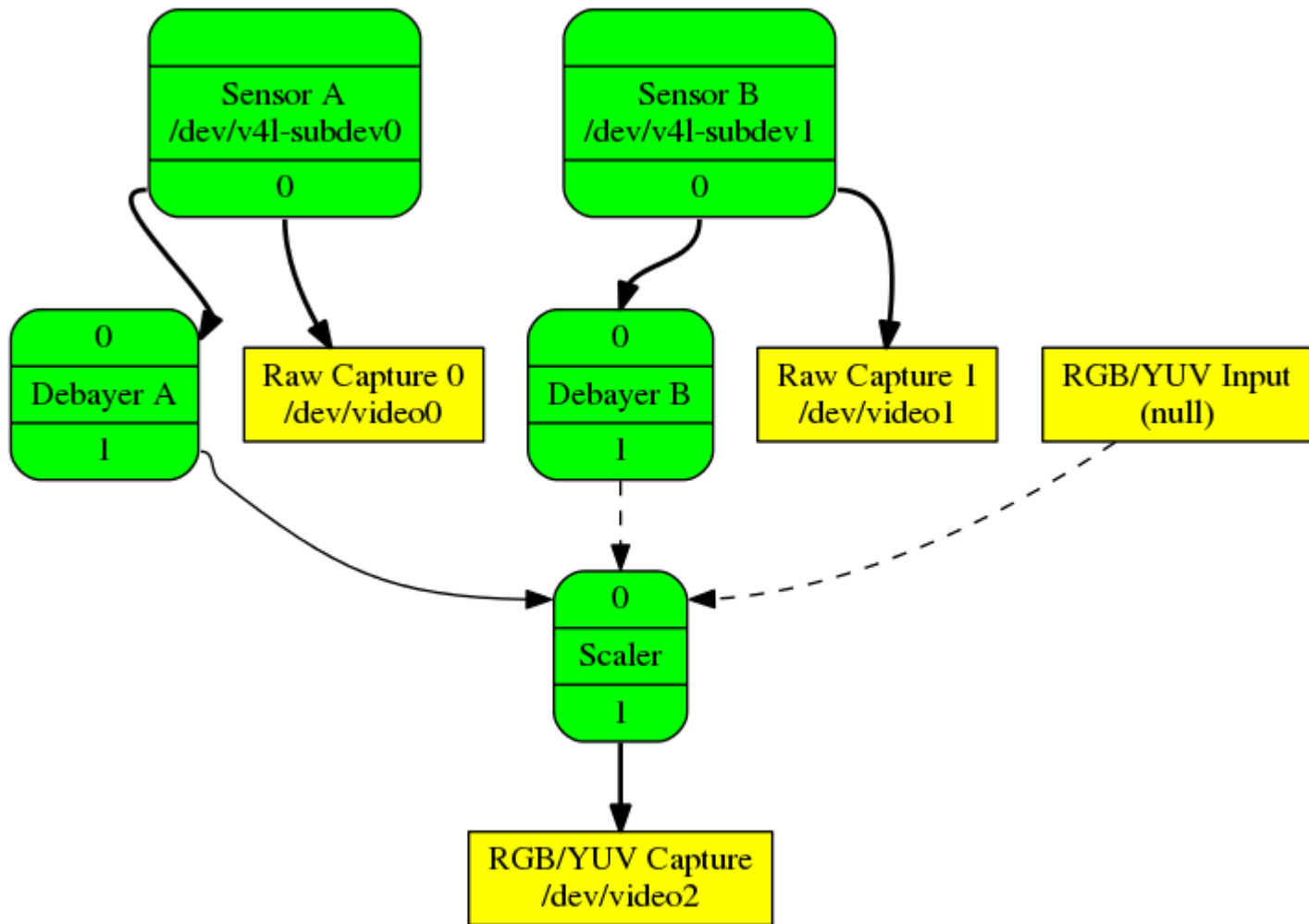
Vimc Driver

- Proposed by Laurent Pinchart for Outreachy in 2015
- Merged in Kernel 4.12
- Moving slowly



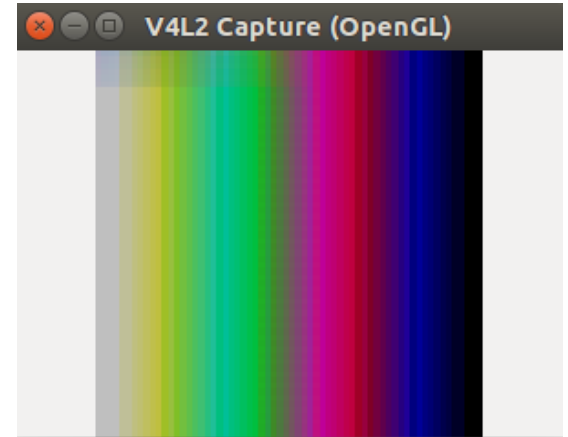
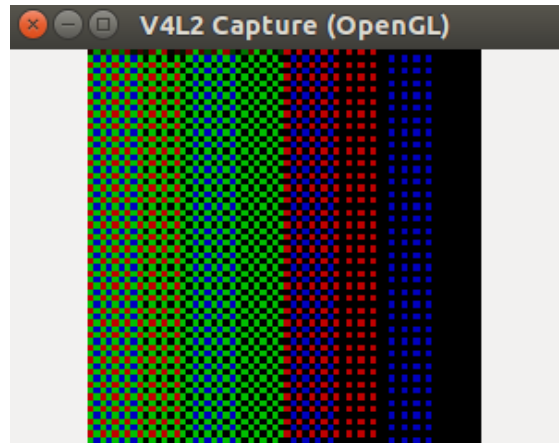
Vimc Driver: current state

- Basic standard submodules:
 - vimc-capture.ko
 - vimc-sensor.ko
 - vimc-debayer.ko
 - vimc-scaler.ko
- Hard-coded topology (re-compilation required)





Vimc Driver





Userspace tools

- v4l-utils

```
media-ctl -d /dev/media0 --print-dot > /tmp/out.dot && xdot /tmp/out.dot
```

```
media-ctl -d /dev/media0 -v "'Sensor A':0[fmt:RGB888_1X24/600x600]"
```

```
media-ctl -v -d /dev/media0 --links "'Debayer A':1->'Scaler':0 [0]"
```

- Yavta (Yet Another V4L2 Test Application)

```
yavta --format RGB24 --size 600x600 /dev/video0
```

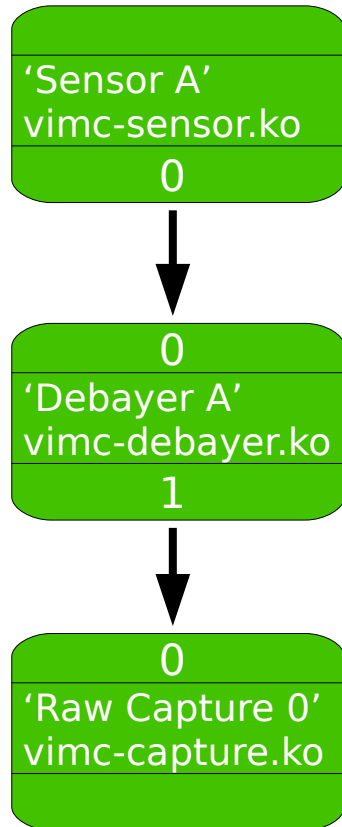


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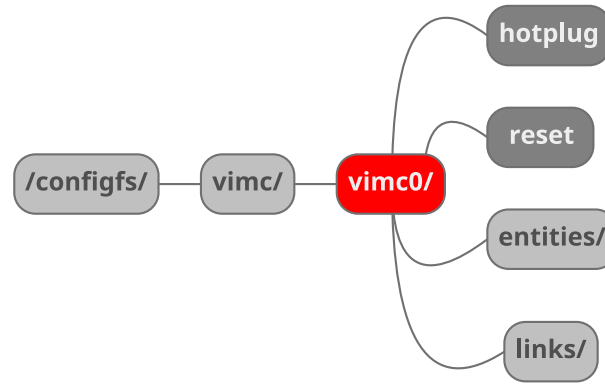
Configs API: Topology



- Entities
 - Name
 - Submodule
- Pads
 - Source
 - Sink
- Links

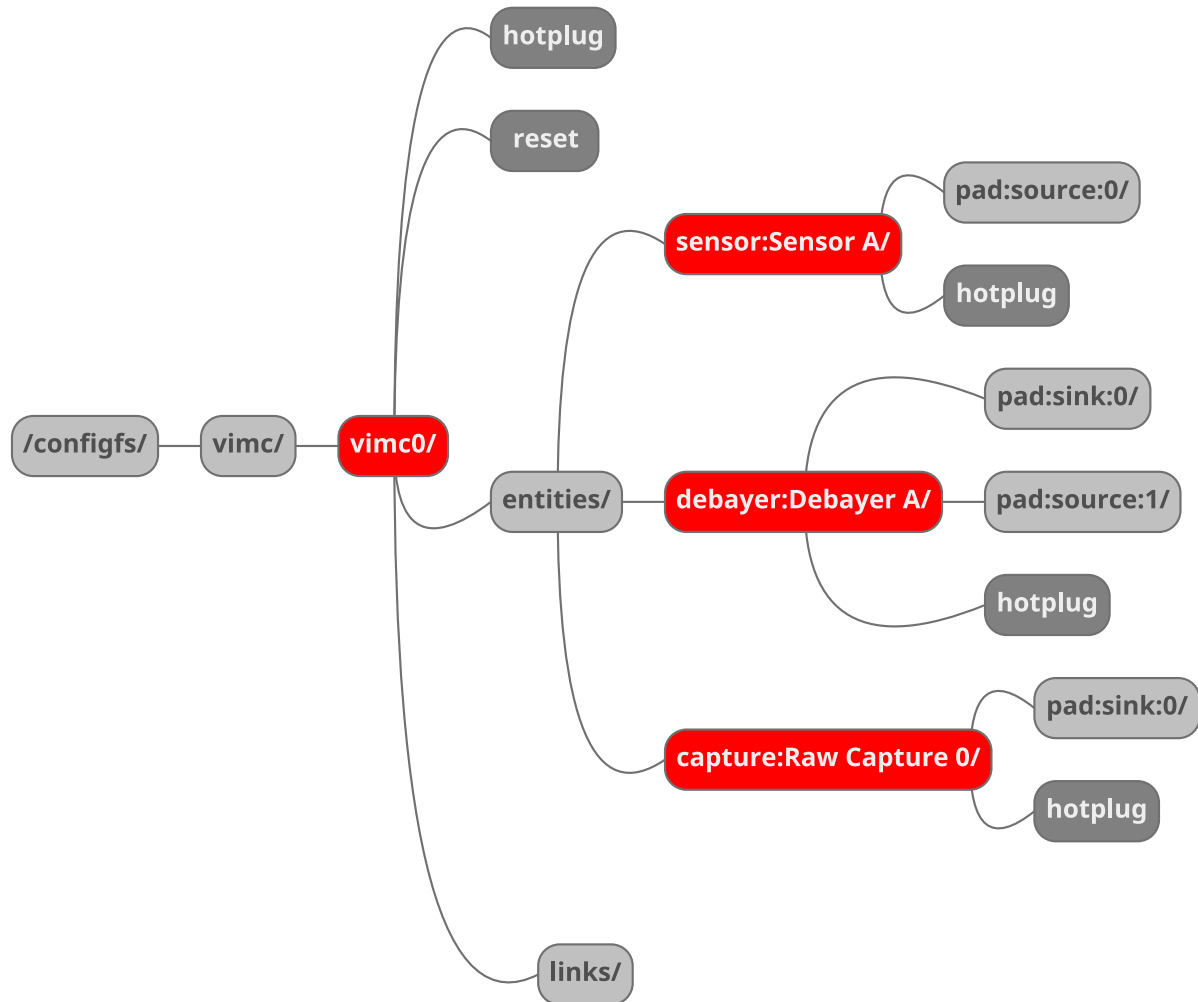
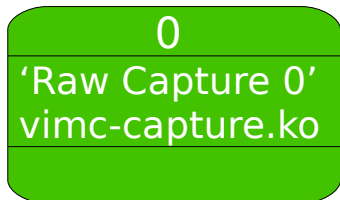
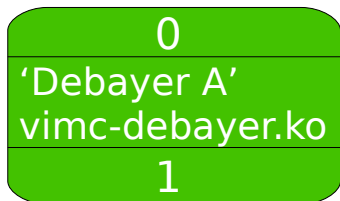
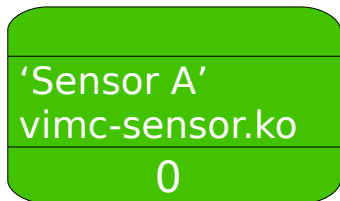


mkdir "MEDIA_NAME"



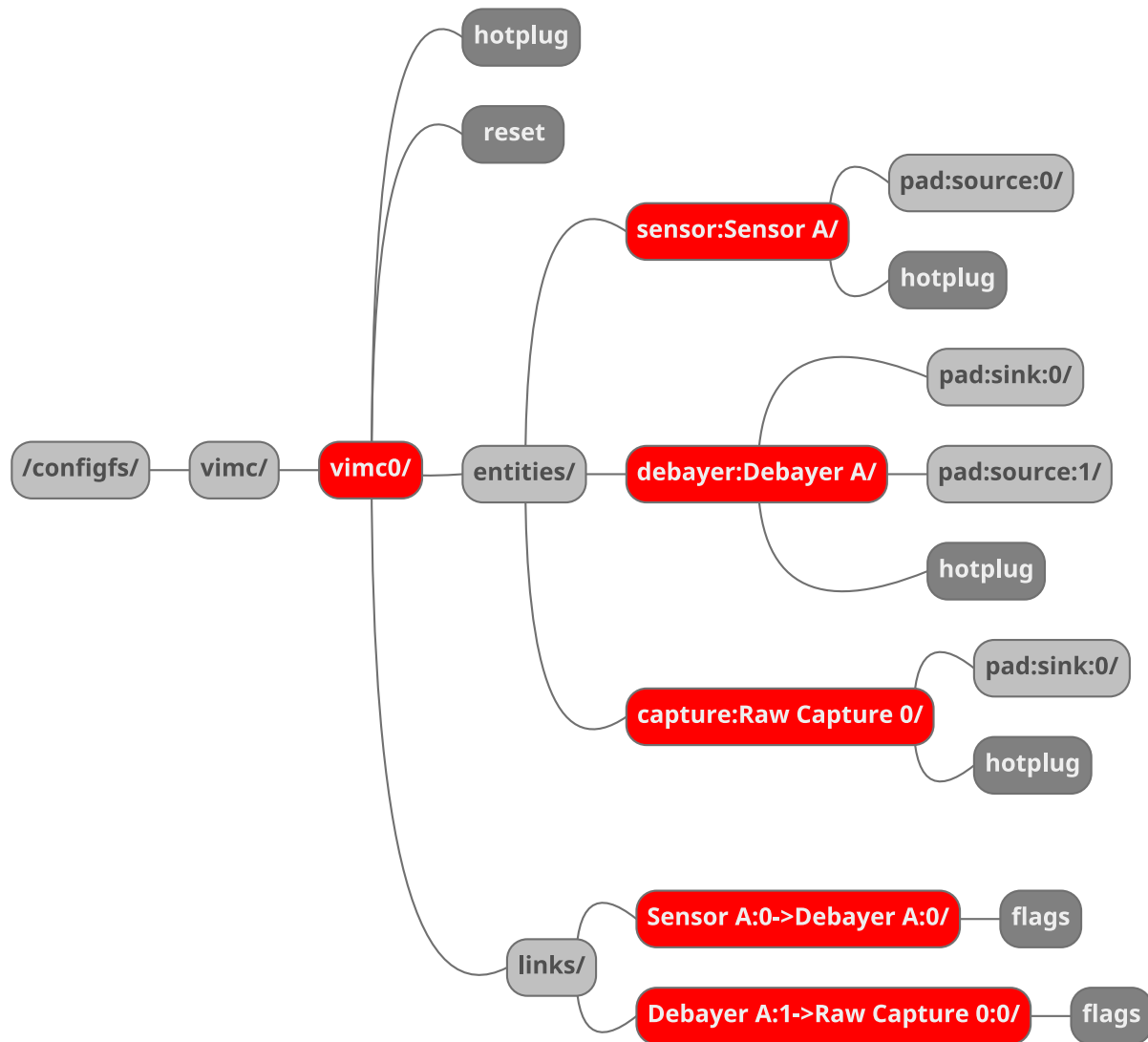
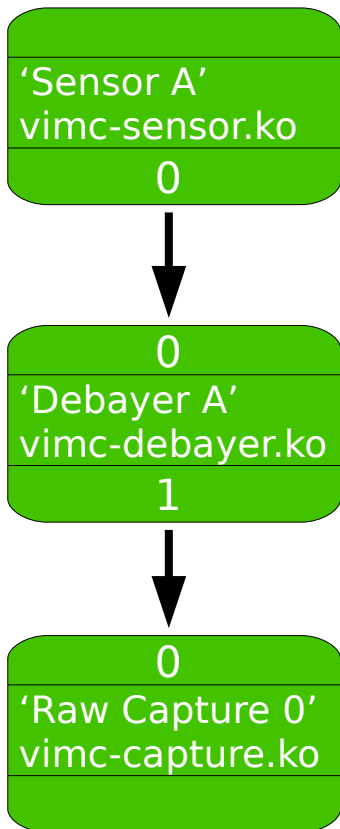


mkdir "SUBMOD:NAME"





mkdir "NAME1:PAD->NAME2:PAD"





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Vimc Driver: future work

- API in Configfs (WIP)
 - Partial implementation (links are missing)
- More controls:
 - LKCAMP
- Image generation directly from capture node (WIP)
 - LKCAMP

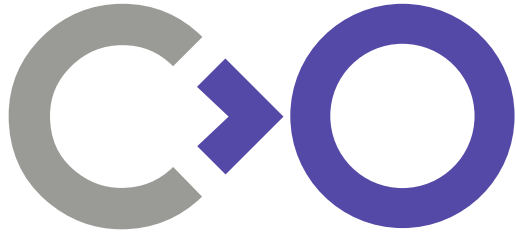


Vimc Driver: future work

- Optimizations of img processing in the pipeline
 - Multi-threaded
- Submodules for output: HDMI / S-Video
- GUI User space tool
- More standard submodules
- Add more V4L2 mechanisms / controls / options



COLLABORA



Thank you!

Helen Koike

helen.koike@collabora.com

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