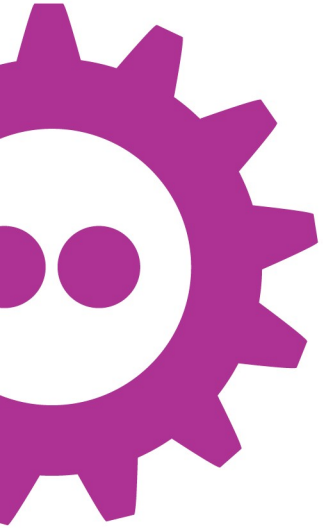




COLLABORA



Modern tools to debug GStreamer applications



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FOSDEM¹⁸



Plan

- Tracers
- Leak tracer
- GstShark
- Dealing with logs



GstTracer

- Introduced in 1.8
- Tracing module loaded at run time
- Post-run analysis and live introspection
- Monitoring hooks
- Formatted output



Stats tracer

- `$ GST_DEBUG_FILE=stats.log GST_DEBUG="GST_TRACER:7" GST_TRACERS="stats;rusage" gst-launch-1.0 videotestsrc num-buffers=10 ! x264enc ! fakesink`
- `$ gst-stats-1.0 stats.log`

```
Overall Statistics:
Number of Threads: 2
Number of Elements: 3
Number of Bins: 1
Number of Pads: 4
Number of GhostPads: 0
Number of Buffers passed: 20
Number of Events sent: 11
Number of Message sent: 53
Number of Queries sent: 45
Time: 0:00:00.070967901
Avg CPU load: 32.9 %

Thread 0x259c100 Statistics:
Time: 0:00:00.041456590
Avg CPU load: 58.4 %
Pad Statistics:
> videotestsrc0.src      : buffers      10 (live   0,dec   0,dis   1,res   0,cor   0,mar   0,hdr   0,gap   0,drop   0,dlt   0), size (min/avg/max) ...../ 230400/....., time 0:0
0:00.004434949, bytes/sec 519509919.956239
> x264enc0.src           : buffers      10 (live   0,dec   0,dis   1,res   0,cor   0,mar   0,hdr   0,gap   0,drop   0,dlt   9), size (min/avg/max) 4747/ 5165/ 5549, time 0:0
0:00.012939531, bytes/sec 3991643.901158

Element Statistics:
GstVideoTestSrc:videotestsrc0      : buffers in/out   -/   10 bytes in/out   -/   2304000 first activity 0:00:00.037026819, ev/msg/qry sent 4/ 6/ 10
GstX264Enc:x264enc0                : buffers in/out   10/   10 bytes in/out 2304000/ 51673 first activity 0:00:00.037026820, ev/msg/qry sent 6/ 7/ 21
GstFakeSink:fakesink0              : buffers in/out   10/   - bytes in/out   51673/ - first activity 0:00:00.053152823, ev/msg/qry sent 1/ 11/ 14
```



Latency tracer

- Measure the time it took for each buffer to travel from source to sink.
- `$ GST_DEBUG="GST_TRACER:7" GST_TRACERS=latency gst-launch-1.0 v4l2src ! videoconvert ! x264enc tune=zerolatency ! queue ! avdec_h264 ! queue ! glimagesink`

```
0:00:00.928258936 19577 0x246b5e0 TRACE GST_TRACER :0:: latency, src=(string)v4l2src0_src, sink=(string)sink_sink, time=(guint64)71297561, ts=(guint64)928248458;
0:00:01.030776025 19577 0x246b5e0 TRACE GST_TRACER :0:: latency, src=(string)v4l2src0_src, sink=(string)sink_sink, time=(guint64)73922897, ts=(guint64)1030767549;
0:00:01.337398699 19577 0x246b5e0 TRACE GST_TRACER :0:: latency, src=(string)v4l2src0_src, sink=(string)sink_sink, time=(guint64)80403701, ts=(guint64)1337385468;
0:00:01.622450191 19577 0x246b5e0 TRACE GST_TRACER :0:: latency, src=(string)v4l2src0_src, sink=(string)sink_sink, time=(guint64)69588841, ts=(guint64)1622441553;
0:00:01.919096329 19577 0x246b5e0 TRACE GST_TRACER :0:: latency, src=(string)v4l2src0_src, sink=(string)sink_sink, time=(guint64)66208117, ts=(guint64)1919086822;
0:00:02.233177028 19577 0x246b5e0 TRACE GST_TRACER :0:: latency, src=(string)v4l2src0_src, sink=(string)sink_sink, time=(guint64)80234987, ts=(guint64)2233167879;
```



Leaks tracer

- Track refcounts of GObject and GstMiniObject
 - Only track leaks in gst code!
- Raise a warning on leaks
- Integrated in 1.10 (core)
- No false positives
- Much lighter/faster than Valgrind



Tracking leaks

- `$ GST_DEBUG="GST_TRACER:7" GST_TRACERS=leaks gst-launch-1.0 v4l2src num-buffers=10 ! videoconvert ! x264enc tune=zerolatency ! queue ! avdec_h264 ! queue ! glimagesink`

```
Got EOS from element "pipeline0".
Execution ended after 0:00:01.724254481
Setting pipeline to PAUSED ...
Setting pipeline to READY ...
Setting pipeline to NULL ...
Freeing pipeline ...
0:00:01.928941544 21379 0x1b15300 TRACE GST_TRACER :0:: object-alive, type-name=(string)GstGLDisplayWayland, address=(gpointer)0x1c13030, description=(string)<gldisplaywayland0>, ref-count=(uint)1, trace=(string);
** (gst-launch-1.0:21379): WARNING **: Leaks detected
```



Tracking leaks: stack trace

- Libunwind
- `GST_TRACERS="leaks(stack-traces-flags=full,filters=GstGLDisplayWayland)"`

```
0:00:02.128372631 22597 0x192a300 TRACE GST_TRACER :0:: object-alive, type-name=(string)GstGLDisplayWayland, address=(gpointer)0x1a24030, description=(string)<gldisplaywayland0>, ref-count=(uint
)1, trace=(string)gst_debug_get_stack_trace (gstinfo.c:2791)
handle_object_created.part.1 (gstleaks.c:330)
gst_object_constructed (gstobject.c:141)
g_object_new_internal (/usr/lib64/libgobject-2.0.so.0.5000.3:0x7f2bca7e8c13)
g_object_newv (/usr/lib64/libgobject-2.0.so.0.5000.3:0x7f2bca7ea0a9)
g_object_new (/usr/lib64/libgobject-2.0.so.0.5000.3:0x7f2bca7ea860)
gst_gl_display_wayland_new (gstgldisplay_wayland.c:122)
gst_gl_display_new (gstgldisplay.c:297)
gst_gl_ensure_element_data (gstglutils.c:295)
gst_glimage_sink_change_state (gstglimagesink.c:1152)
gst_element_change_state (gstelement.c:2952)
gst_element_set_state_func (gstelement.c:2906)
gst_bin_change_state_func (gstbin.c:2602)
gst_element_change_state (gstelement.c:2952)
gst_element_set_state_func (gstelement.c:2906)
gst_bin_change_state_func (gstbin.c:2602)
gst_element_change_state (gstelement.c:2952)
gst_element_set_state_func (gstelement.c:2906)
main (gst-launch.c:1133)
__libc_start_main (/usr/lib64/libc-2.24.so:0x7f2bca21042d)
_start (/home/cassidy/dev/gst/master/gst-build/build/subprojects/gstreamer/tools/gst-launch-1.0:0x403db6)
;

** (gst-launch-1.0:22597): WARNING **: Leaks detected
```




Leaks tracer: extra features

- Track ref/unref operations (check-refs=true)
- List alive objects while running (SIGUSR1)
- Check points (SIGUSR2)

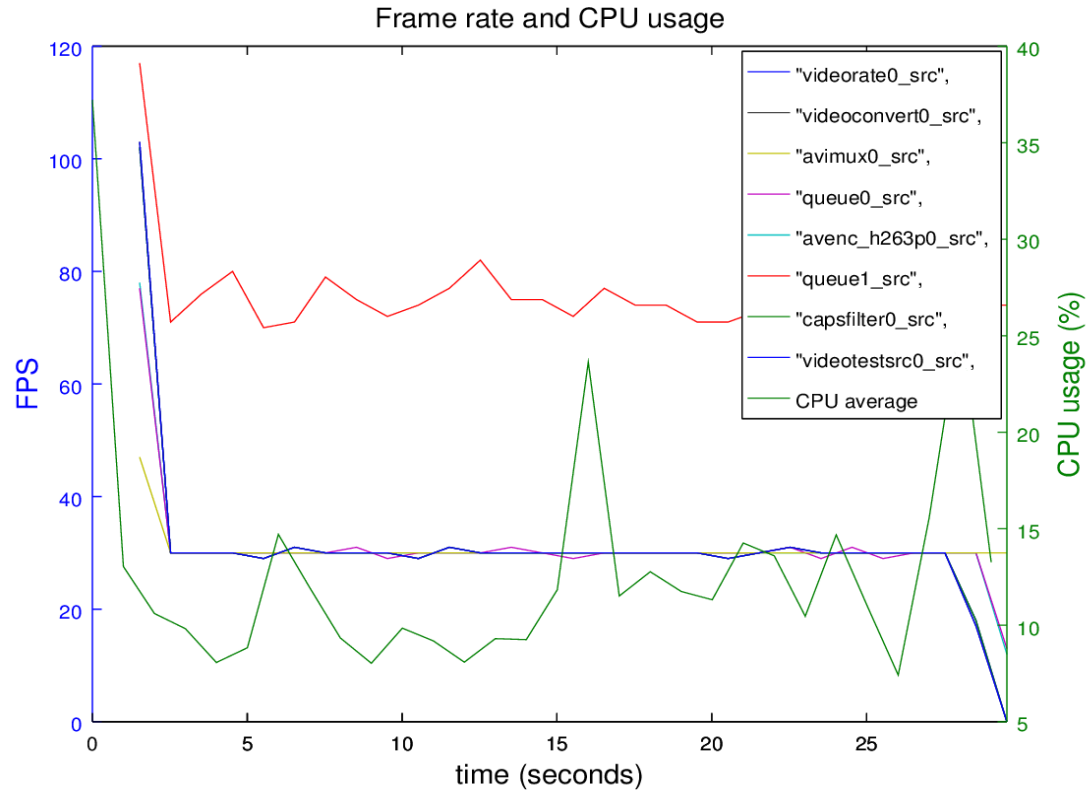


GstShark: tracers

- Inter latency
- Buffer rate on src pad
- Schedule time
- Queues level
- ...
- <https://github.com/RidgeRun/gst-shark>



GstShark: visualization



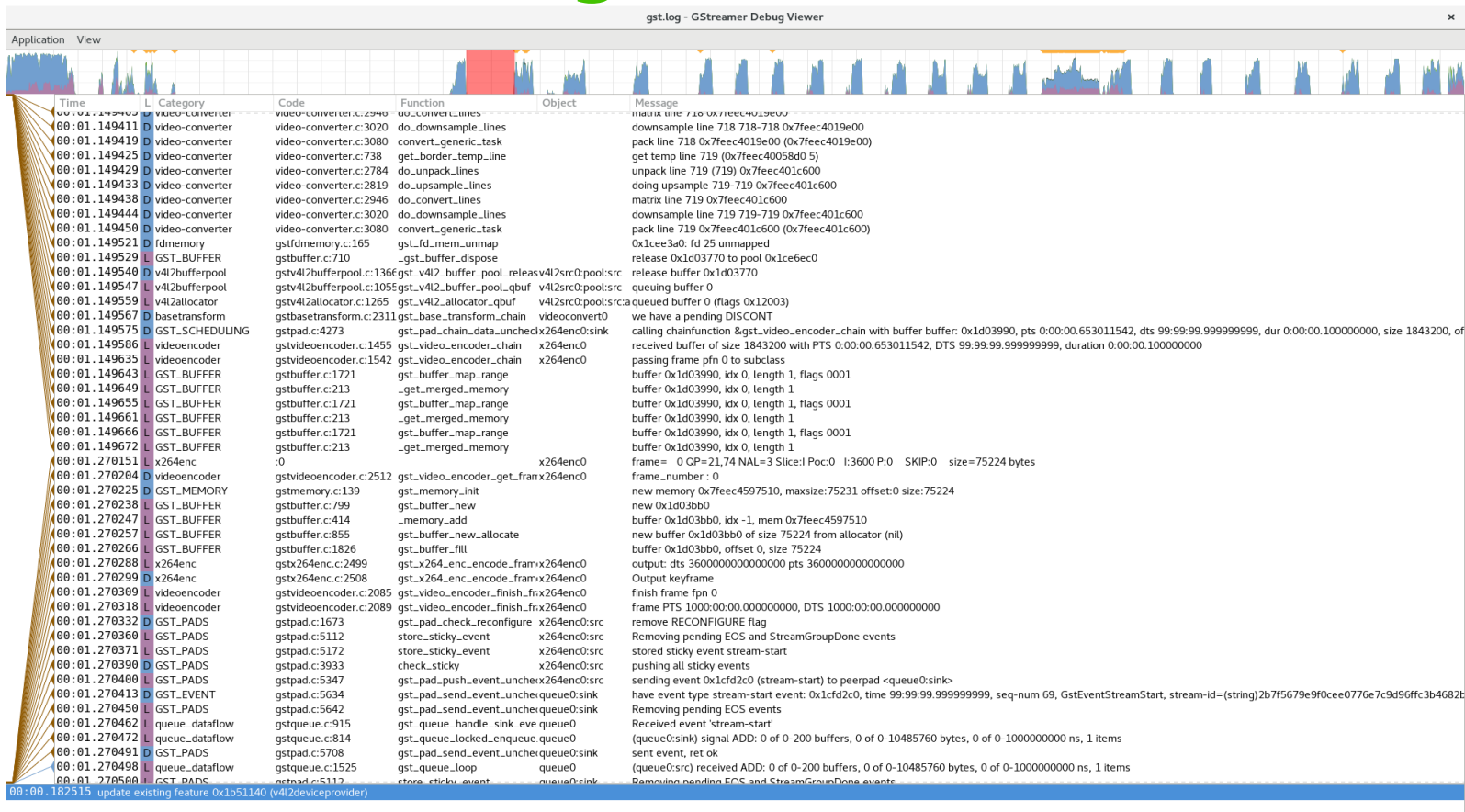


Dealing with GStreamer logs

```
0:00:00.365340174 25115 0x1cefa80 LOG GST_PADS gstpad.c:5347:gst_pad_push_event_unchecked:<v4l2src0:src> sending event 0x1cfd2c0 (stream-start) to peerpad <videoconvert0:sink>
0:00:00.365345921 25115 0x19ea800 DEBUG GST_BUS gstbus.c:318:gst_bus_post:<bus2> [msg 0x1d13430] posting on bus state-changed message: 0x1d13430, time 99:99:99.999999999, seq-num 70, element
0:00:00.365347247 25115 0x1cefa80 DEBUG GST_EVENT gstpad.c:5634:gst_pad_send_event_unchecked:<videoconvert0:sink> have event type stream-start event: 0x1cfd2c0, time 99:99:99.999999999, seq-num
0:00:00.365368254 25115 0x1cefa80 LOG GST_PADS gstpad.c:5642:gst_pad_send_event_unchecked:<videoconvert0:sink> Removing pending EOS events
0:00:00.365374369 25115 0x1cefa80 LOG GST_PADS gstpad.c:5112:store_sticky_event:<videoconvert0:src> Removing pending EOS and StreamGroupDone events
0:00:00.365379038 25115 0x1cefa80 LOG GST_PADS gstpad.c:5172:store_sticky_event:<videoconvert0:src> stored sticky event stream-start
0:00:00.365381558 25115 0x19ea800 DEBUG GST_BUS gstbus.c:357:gst_bus_post:<bus2> [msg 0x1d13430] pushing on async queue
0:00:00.365384001 25115 0x1cefa80 DEBUG GST_PADS gstpad.c:3933:check_sticky:<videoconvert0:src> pushing all sticky events
0:00:00.365393641 25115 0x19ea800 DEBUG GST_BUS gstbus.c:360:gst_bus_post:<bus2> [msg 0x1d13430] pushed on async queue
0:00:00.365400280 25115 0x1cefa80 LOG GST_PADS gstpad.c:5347:gst_pad_push_event_unchecked:<videoconvert0:src> sending event 0x1cfd2c0 (stream-start) to peerpad <x264enc0:sink>
0:00:00.365408763 25115 0x19ea800 LOG GST_STATES gstelement.c:3004:gst_element_change_state:<pipeline0> exit state change 3
0:00:00.365410279 25115 0x1cefa80 DEBUG GST_EVENT gstpad.c:5634:gst_pad_send_event_unchecked:<x264enc0:sink> have event type stream-start event: 0x1cfd2c0, time 99:99:99.999999999, seq-num 69,
0:00:00.365425362 25115 0x19ea800 LOG GST_STATES gstelement.c:3004:gst_element_change_state:<pipeline0> exit state change 3
0:00:00.365431717 25115 0x1cefa80 LOG GST_PADS gstpad.c:5642:gst_pad_send_event_unchecked:<x264enc0:sink> Removing pending EOS events
0:00:00.365439036 25115 0x19ea800 DEBUG GST_STATES gstelement.c:2911:gst_element_set_state_func:<pipeline0> returned NO PREROLL
0:00:00.365445006 25115 0x1cefa80 DEBUG gstvideoencoder.c:1206:gst_video_encoder_sink_event:<x264enc0> received event 10254, stream-start
0:00:00.365454591 25115 0x1cefa80 DEBUG gstvideoencoder.c:1108:gst_video_encoder_sink_event default:<x264enc0> STREAM START, clearing upstream tags
0:00:00.365461106 25115 0x1cefa80 DEBUG GST_PADS gstpad.c:5708:gst_pad_send_event_unchecked:<x264enc0:sink> sent event, ret ok
0:00:00.365463559 25115 0x19ea800 DEBUG GST_BUS gstelement.c:3402:gst_element_get_bus:<pipeline0> got bus <bus2>
0:00:00.365471790 25115 0x1cefa80 LOG GST_PADS gstpad.c:5112:store_sticky_event:<x264enc0:sink> Removing pending EOS and StreamGroupDone events
0:00:00.365481258 25115 0x1cefa80 LOG GST_PADS gstpad.c:5172:store_sticky_event:<x264enc0:sink> stored sticky event stream-start
0:00:00.365488850 25115 0x1cefa80 LOG GST_PADS gstpad.c:5355:gst_pad_push_event_unchecked:<videoconvert0:src> sent event 0x1cfd2c0 (stream-start) to peerpad <x264enc0:sink>, ret ok
0:00:00.365498779 25115 0x1cefa80 DEBUG GST_PADS gstpad.c:3885:push_sticky:<videoconvert0:src> event stream-start marked received
```



GStreamer Debug Viewer





gst-log-parser

- GStreamer logs parsing library 
- High level objects to manipulate logs
- Easy filtering, mapping, etc (iterator)
- <https://github.com/gdesmott/gst-log-parser/>



Gst-log-parser: ts-diff

- Highlight highest timestamps gaps (per thread)

```
00:00:02.185091401 (00:00:00.000034454 00:00:00.029690259) 0x1eae6770 Log v4l2allocator gstv4l2allocator.c:1256:gst_v4l2_allocator_qbuf:<v4l2src0:pool:src:allocator> queued buffer 3 (flags 0x2003)
00:00:02.186883020 (00:00:00.028987409 00:00:00.029632563) 0x1eae6320 Log v4l2bufferpool gstv4l2bufferpool.c:1149:gst_v4l2_buffer_pool_dqbuf:<v4l2src0:pool:src> dequeuing a buffer
00:00:02.186913483 (00:00:00.000030463 00:00:00.029628243) 0x1eae6320 Log v4l2allocator gstv4l2allocator.c:1306:gst_v4l2_allocator_dqbuf:<v4l2src0:pool:src:allocator> dequeued buffer 0 (flags 0x2001)
00:00:02.186944936 (00:00:00.000031453 00:00:00.029613921) 0x1eae6320 Log v4l2bufferpool gstv4l2bufferpool.c:1181:gst_v4l2_buffer_pool_dqbuf:<v4l2src0:pool:src> dequeued buffer 0x7f78011040 seq:60 (ix=0), mem 0x
leaf84b0 used 12441600, plane=0, flags 00002001, ts 0:50:34.718414000, pool-queued=3, buffer=0x7f78011040
00:00:02.186997521 (00:00:00.000052585 00:00:00.029605280) 0x1eae6320 Debug v4l2bufferpool gstv4l2bufferpool.c:1704:gst_v4l2_buffer_pool_process:<v4l2src0:pool:src> process buffer 0x7f80e37768
00:00:02.187031475 (00:00:00.000033954 00:00:00.029592209) 0x1eae6320 Debug v4l2src gstv4l2src.c:843:gst_v4l2src_create:<v4l2src0> ts: 0:50:34.718414000 now 0:50:34.718577194 delay 0:00:00.000163194
00:00:02.187089441 (00:00:00.000057966 00:00:00.029583889) 0x1eae6320 Info v4l2src gstv4l2src.c:879:gst_v4l2src_create:<v4l2src0> sync to 0:00:02.033333313 out ts 0:00:02.117560219
00:00:02.187470939 (00:00:00.000381498 00:00:00.029606831) 0x1eae6320 Debug v4l2bufferpool gstv4l2bufferpool.c:1300:gst_v4l2_buffer_pool_acquire_buffer:<v4l2src0:pool:src> acquire
00:00:02.187492221 (00:00:00.000021282 00:00:00.029596610) 0x1eae6320 Log v4l2bufferpool gstv4l2bufferpool.c:1017:gst_v4l2_buffer_pool_poll:<v4l2src0:pool:src> polling device
00:00:02.216512143 (00:00:00.029019922 00:00:00.029629123) 0x1eae6320 Log v4l2bufferpool gstv4l2bufferpool.c:1149:gst_v4l2_buffer_pool_dqbuf:<v4l2src0:pool:src> dequeuing a buffer
00:00:02.216544276 (00:00:00.000032133 00:00:00.029630793) 0x1eae6320 Log v4l2allocator gstv4l2allocator.c:1306:gst_v4l2_allocator_dqbuf:<v4l2src0:pool:src:allocator> dequeued buffer 1 (flags 0x2001)
00:00:02.216573999 (00:00:00.000029723 00:00:00.029629063) 0x1eae6320 Log v4l2bufferpool gstv4l2bufferpool.c:1181:gst_v4l2_buffer_pool_dqbuf:<v4l2src0:pool:src> dequeued buffer 0x7f78011150 seq:61 (ix=1), mem 0x
leaf8660 used 12441600, plane=0, flags 00002001, ts 0:50:34.748047000, pool-queued=2, buffer=0x7f78011150
00:00:02.216619964 (00:00:00.000045965 00:00:00.029622443) 0x1eae6320 Debug v4l2bufferpool gstv4l2bufferpool.c:1704:gst_v4l2_buffer_pool_process:<v4l2src0:pool:src> process buffer 0x7f80e37768
00:00:02.216647916 (00:00:00.000027952 00:00:00.029616441) 0x1eae6320 Debug v4l2src gstv4l2src.c:843:gst_v4l2src_create:<v4l2src0> ts: 0:50:34.748047000 now 0:50:34.748194466 delay 0:00:00.000147466
00:00:02.216690381 (00:00:00.000042465 00:00:00.029600940) 0x1eae6320 Info v4l2src gstv4l2src.c:879:gst_v4l2src_create:<v4l2src0> sync to 0:00:02.066666646 out ts 0:00:02.147193219
00:00:02.217050137 (00:00:00.000359756 00:00:00.029579198) 0x1eae6320 Debug v4l2bufferpool gstv4l2bufferpool.c:1300:gst_v4l2_buffer_pool_acquire_buffer:<v4l2src0:pool:src> acquire
00:00:02.217071449 (00:00:00.000021312 00:00:00.029579228) 0x1eae6320 Log v4l2bufferpool gstv4l2bufferpool.c:1017:gst_v4l2_buffer_pool_poll:<v4l2src0:pool:src> polling device
00:00:02.222022314 (00:00:00.036930913 00:00:00.036995570) 0x1eae6770 Debug v4l2bufferpool gstv4l2bufferpool.c:1378:gst_v4l2_buffer_pool_release_buffer:<v4l2src0:pool:src> release buffer 0x7f78011040
00:00:02.222059878 (00:00:00.000037564 00:00:00.037002931) 0x1eae6770 Log v4l2bufferpool gstv4l2bufferpool.c:1078:gst_v4l2_buffer_pool_qbuf:<v4l2src0:pool:src> queuing buffer 0
```



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Any questions?

