

Latency is Bad... Isn't it?

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What's Latency?

“ Latent: *something is present, existing, or capable of developing, but is currently hidden, inactive, or not visibly apparent* ”

- Derived from latēre, meaning "to lie hidden"
- Ergo: *Latency*: In the condition of being concealed or lying dormant

Example



Latency Definition

- The time difference between event A and event B
- A delay we need to minimise
- In **live** systems
 - We don't tend to talk about "latency" otherwise

What does it mean to be live?

- Generates data in "real time"
- -> Buffers only produced in PLAYING
- -> if slower than real-time, data is lost

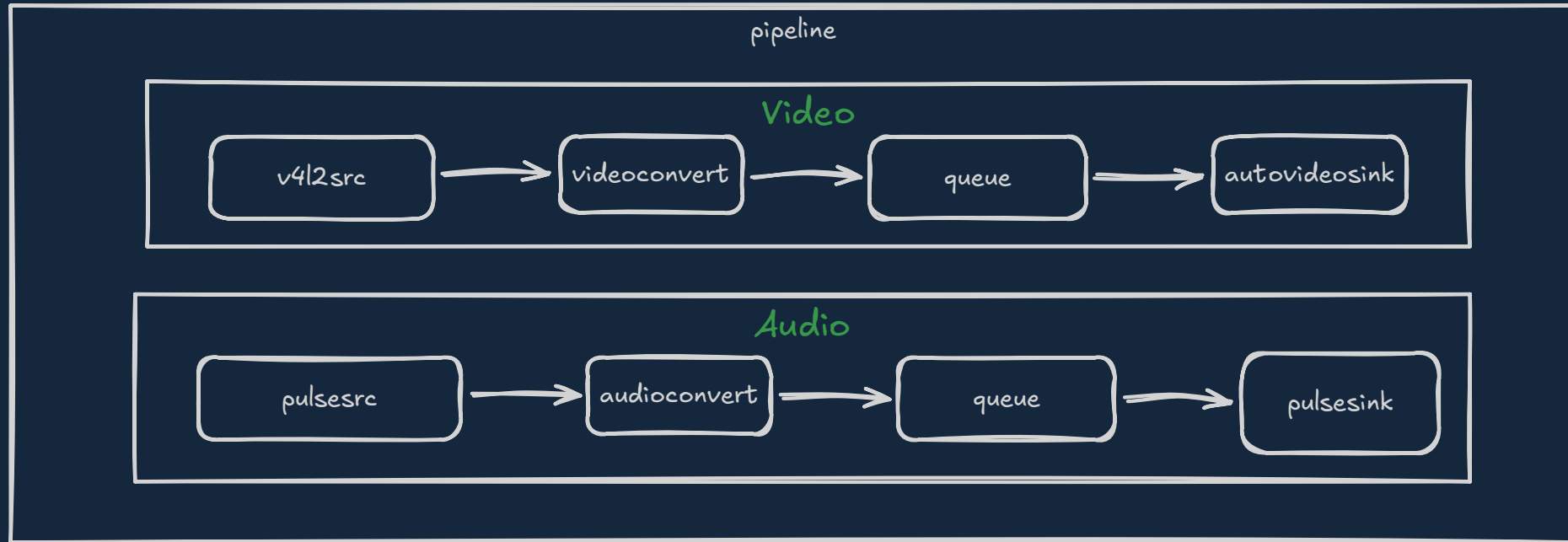
What causes Latency

- Capture time
- Network transmission
- Storage Queues
- Decoder reordering

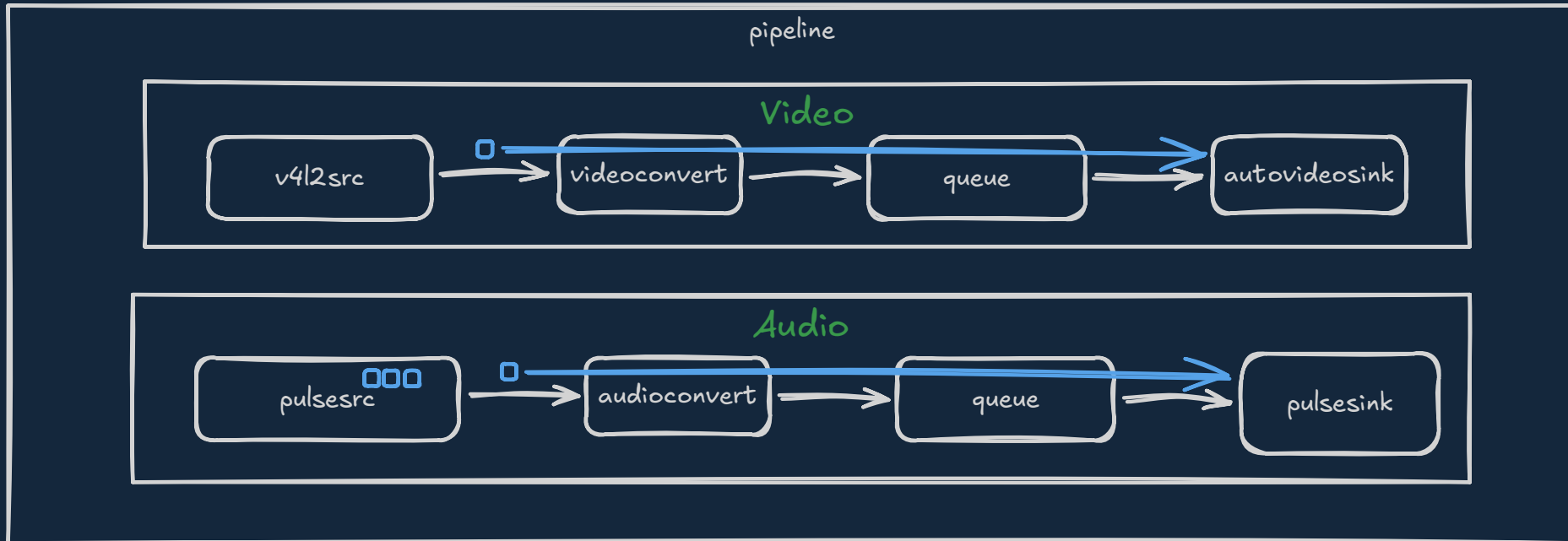
What isn't Latency

- Processing Time/ CPU costs

GStreamer's Latency System



GStreamer's Latency System



We need to preroll

GStreamer's Latency System

Application responsibility

- Receive `GST_MESSAGE_LATENCY` -> call `gst_bin_recalculate_latency()` on the pipeline
- `gst-launch` and friends do this. In your app, you need to
- Who posts the message?

GStreamer's Latency System

```
Got message #73 from element "pulsesrc0" (latency): no message details
Redistribute latency...
Got message #76 from element "pulsesink0" (latency): no message details
Redistribute latency...
Got message #82 from element "pulsesink0" (latency): no message details
Redistribute latency...
Got message #91 from element "autovideosink0-actual-sink-xvimage" (latency): no message details
Redistribute latency...
```

GStreamer's Latency System

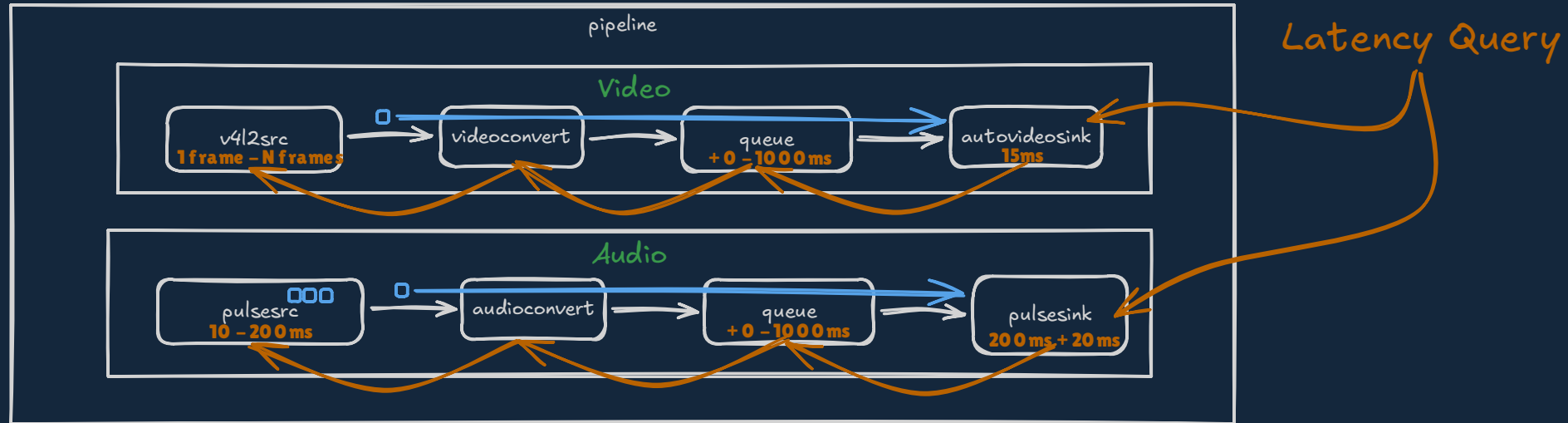
What does `gst_bin_recalculate_latency()` do?

```
query = gst_query_new_latency ();
if ((res = gst_element_query (GST_ELEMENT_CAST (pipeline), query))) {
    gboolean live;

    gst_query_parse_latency (query, &live, &min_latency, &max_latency);
    ... // Choose a latency
    gst_element_send_event (GST_ELEMENT_CAST (pipeline), gst_event_new_latency (latency));
}
```

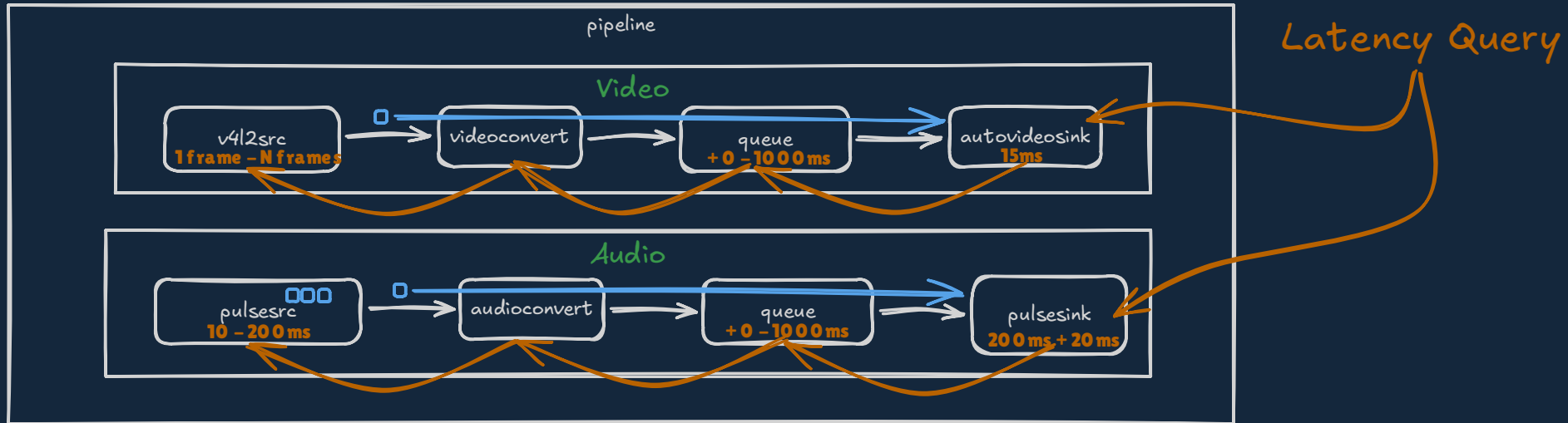
We have a minimum and a maximum latency

GStreamer's Latency System



```
gst_base_sink_query_latency:<pulsesink0> latency query: live: 1, have_latency 1, upstream_live 1,  
  min(0:00:00.030000000)=upstream(0:00:00.010000000)+processing_deadline(0:00:00.020000000)+render_delay(0:00:00.000000000),  
  max(0:00:01.200000000)=upstream(0:00:01.200000000)+render_delay(0:00:00.000000000)  
gst_base_sink_query_latency:<autovideosink0-actual-sink-xvimage> latency query: live: 1, have_latency 1, upstream_live 1,  
  min(0:00:00.048333333)=upstream(0:00:00.033333333)+processing_deadline(0:00:00.015000000)+render_delay(0:00:00.000000000),  
  max(0:00:02.066666656)=upstream(0:00:02.066666656)+render_delay(0:00:00.000000000)
```

Latency and synchronisation



- Every sink has to share the same latency - why?
- Pipeline chooses a latency -> Sends the latency event

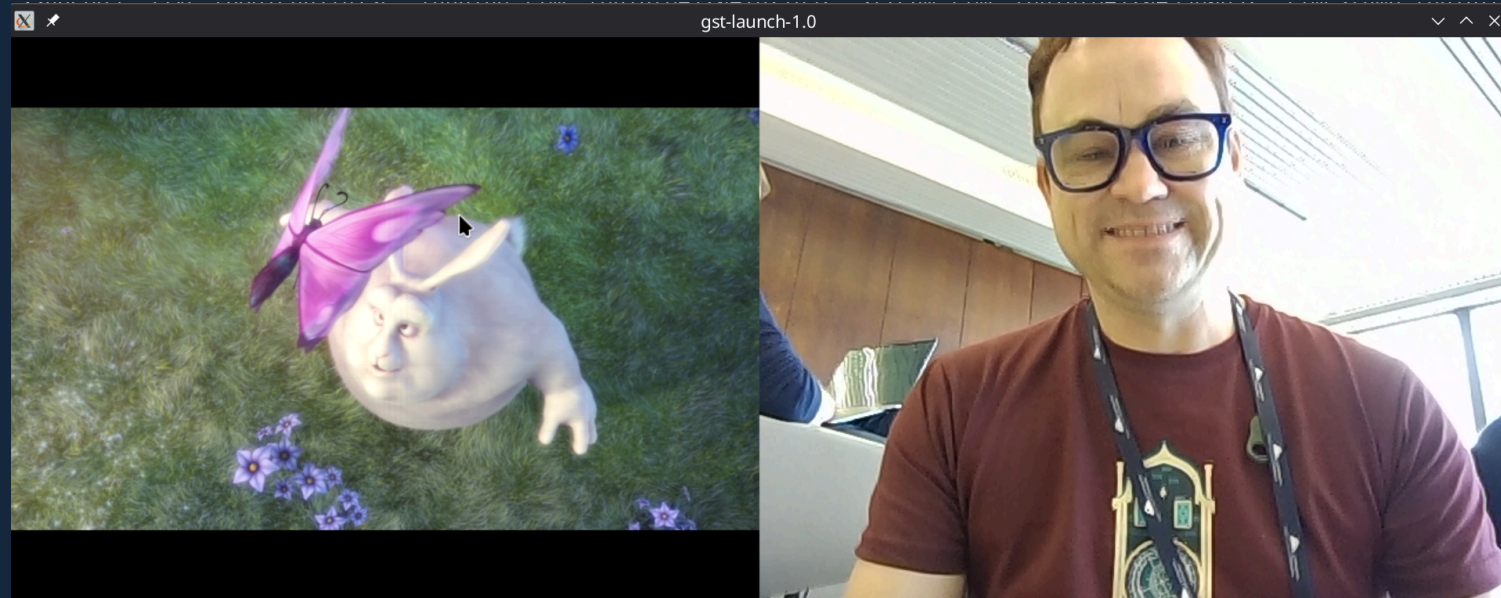
Tuning latency

- Receive Settings
 - jitterbuffer
- Encode Settings
 - B frame reordering
- Queues and ringbuffers
 - queue size affects max latency
 - queue min-threshold-time affects min latency

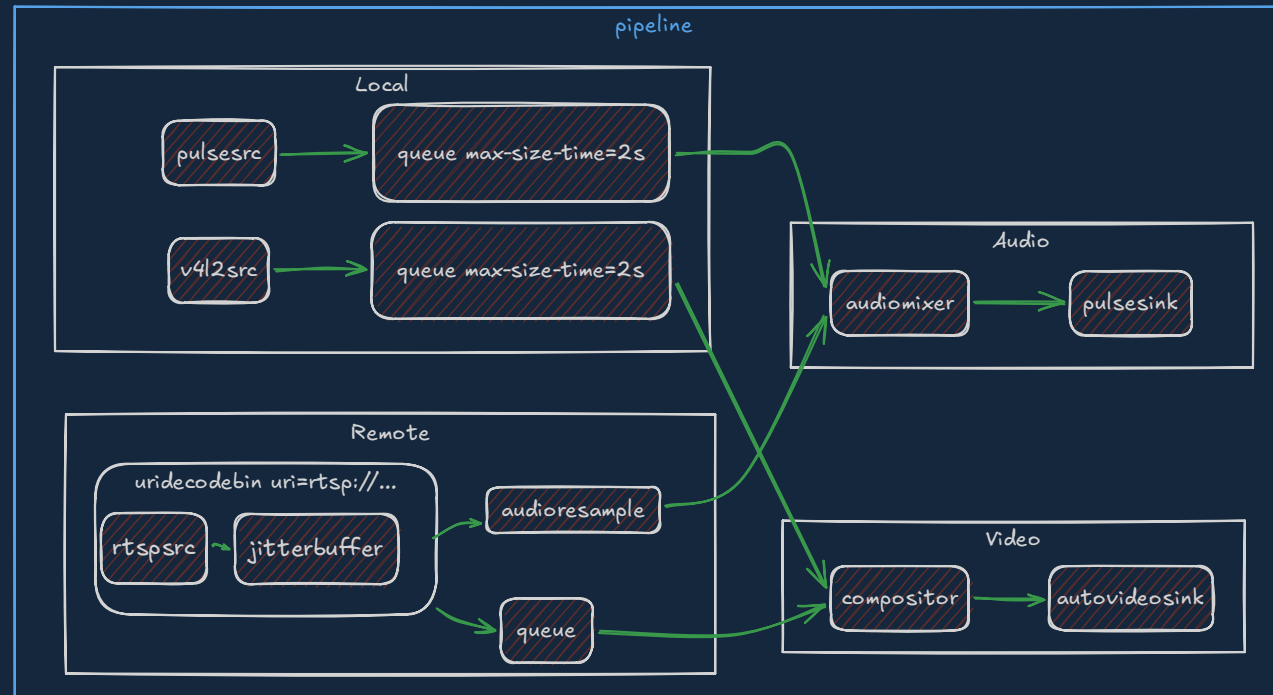
Tuning latency gotchas

- Processing Deadline
 - Default adds 15/20ms
- Worst-case calculations
 - Opus FEC adds 120ms
 - MPEG-TS PTS spacing - 700ms

GStreamer's Latency System



GStreamer's Latency System

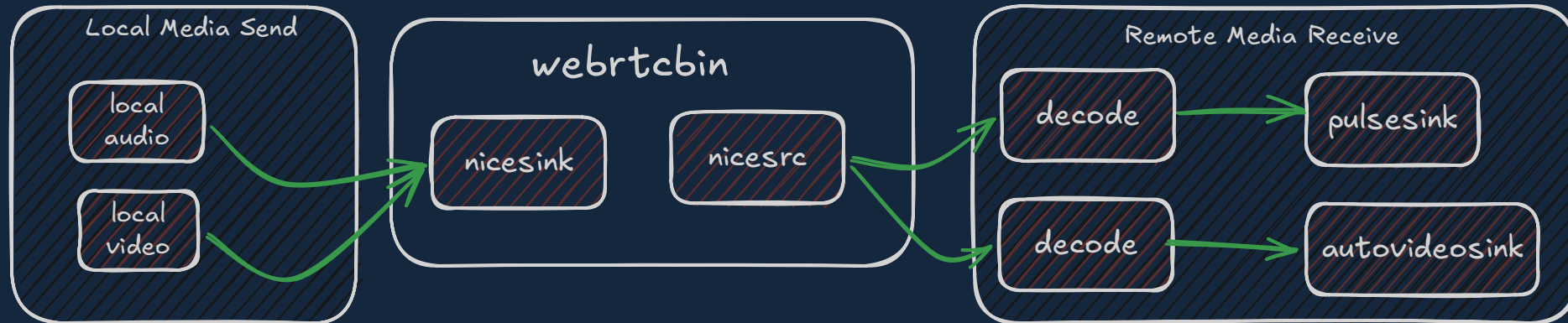


Result: 2 seconds local preview delay!

Limits of GStreamer's Model

- Data / Stream Dependent delays
 - Have to report the worst case
- Not all delays are in time units
- Dynamic latency shifts
 - resizing jitterbuffers to match network conditions
- Independent processing flows
 - Sending shouldn't be bound by receiving

Independent Processing Flows



How else could we do things?

- Explicit latency groups
 - Not 1 latency for the whole pipeline
 - Current workaround: Split up pipelines, or control latency manually everywhere
- Elements that provide hints about moments to adjust latency?
 - Silence detection in audio
- Ways to gradually adjust latency?
 - Resampling
 - Smaller skews

How do you feel about latency now?

“ In the moment when I truly understand my enemy, understand him well enough to defeat him, then in that very moment I also love him. ”

Orson Scott Card

Questions? Comments?



Come talk to us!