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HLS master playlist management made easy

Sanchayan Maity

Who

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- Open source consulting firm based out of Bangalore and Toronto.

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- Building high-quality, low-level systems software.

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- Open source consulting firm based out of Bangalore and Toronto.
- Building high-quality, low-level systems software.
- Providing services for audio/video using GStreamer and PipeWire.

Agenda

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- What's HTTP Live Streaming (HLS)

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- HLS media and multi-variant playlist examples

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- What's HTTP Live Streaming (HLS)
- HLS media and multi-variant playlist examples
- Multi-variant playlist helper bin implementation
- Future work

HLS

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- Developed by Apple and released in 2009
- Standardised in RFC 8216
- HTTP-based adaptive bit-rate streaming communications protocol
- HTTP traffic, unlike UDP-based protocols such as RTP
- Delivered over widely available HTTP-based content delivery networks

Content Delivery Networks[1]

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[1] What's a CDN?

HLS Architecture[2]

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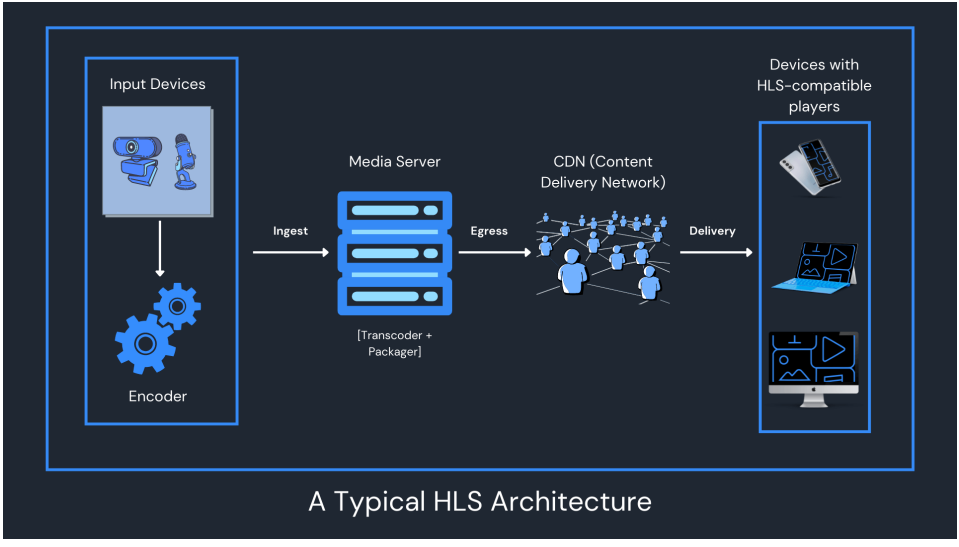

[2] HTTP Live Streaming

Media playlist[3]

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```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-VERSION:3
#EXTINF:9.009,
http://media.example.com/first.ts
#EXTINF:9.009,
http://media.example.com/second.ts
#EXTINF:3.003,
http://media.example.com/third.ts
#EXT-X-ENDLIST
```

[3] RFC 8216

Master/Multivariant playlist[4]

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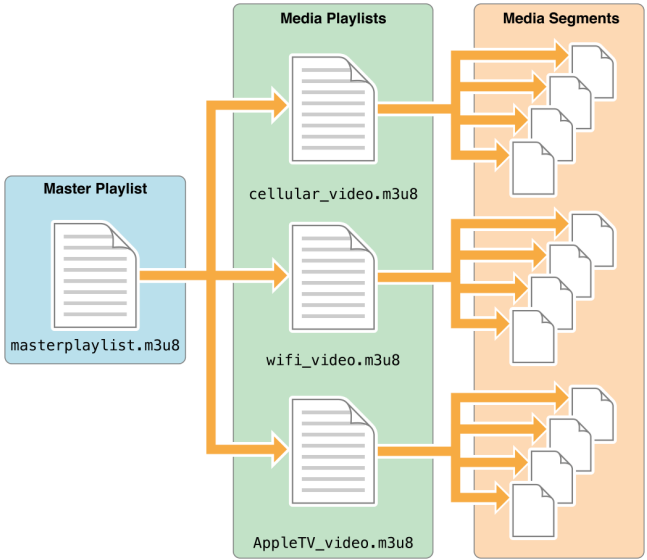

[4] About HTTP Live Streaming

Multivariant playlist[5]

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```
#EXTM3U
#EXT-X-STREAM-INF:BANDWIDTH=1280000,AVERAGE-BANDWIDTH=1000000
http://example.com/low.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=2560000,AVERAGE-BANDWIDTH=2000000
http://example.com/mid.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=7680000,AVERAGE-BANDWIDTH=6000000
http://example.com/hi.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=65000,CODECS="mp4a.40.5"
http://example.com/audio-only.m3u8
```

[5] RFC 8216

Multivariant playlist - I[6]

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```
#EXTM3U
#EXT-X-STREAM-INF:BANDWIDTH=1280000,CODECS="...",AUDIO="aac"
low/video-only.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=2560000,CODECS="...",AUDIO="aac"
mid/video-only.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=7680000,CODECS="...",AUDIO="aac"
hi/video-only.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=65000,CODECS="mp4a.40.5",AUDIO="aac"
main/english-audio.m3u8
```

[6] RFC 8216

Multivariant playlist - II

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```
#EXT-X-MEDIA:TYPE=AUDIO,GROUP-ID="aac",NAME="English", \
   DEFAULT=YES,AUTOSELECT=YES,LANGUAGE="en", \
   URI="main/english-audio.m3u8"
#EXT-X-MEDIA:TYPE=AUDIO,GROUP-ID="aac",NAME="Deutsch", \
   DEFAULT=NO,AUTOSELECT=YES,LANGUAGE="de", \
   URI="main/german-audio.m3u8"
```

- Stream

CODECS[7]

- Stream
  - AAC low complexity (AAC-LC) audio

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  - H.264 Main Profile Level 3.0 video

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- Stream
  - AAC low complexity (AAC-LC) audio
  - H.264 Main Profile Level 3.0 video
  - Codec string: `mp4a.40.2,avc1.4d401e`

[7] RFC 8216

HLS playback

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```
adaptivedemux2:  hlsdemux2: HLS Demuxer
hls:  hlsdemux: HLS Demuxer
libav:  avmux_hls: libav Apple HTTP Live Streaming muxer
typefindfunctions: application/x-hls: m3u8
```

Playback pipeline

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```
gst-play-1.0 https://devstreaming-cdn.apple.com/videos/streaming/examples/
img_bipbop_adv_example_ts/master.m3u8
```

Playback pipeline graph

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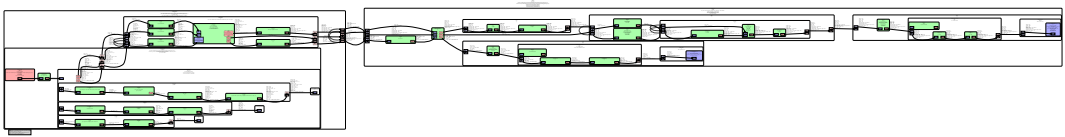

HLS playlist generation

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```
hls:  hlssink: HTTP Live Streaming sink
hls:  hlssink2: HTTP Live Streaming sink
hlssink3:  hlssink3: HTTP Live Streaming sink
hlssink3: hlscmafsink: HTTP Live Streaming CMAF sink
aws: awss3hlssink: Streams HLS data to S3
```

hlsmultivariantsink

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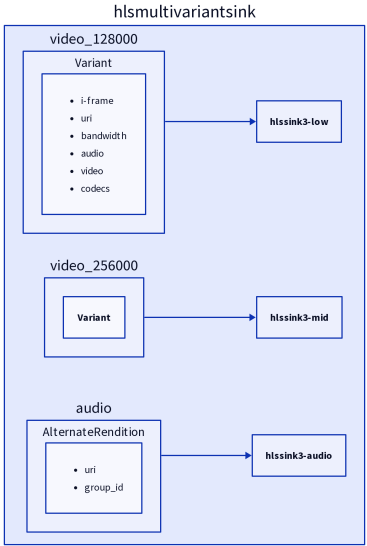

hlsmultivariantsink

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```
SINK template: 'video_%u'
  Availability: On request
  Capabilities:
    ANY
  Type: HlsMultivariantSinkPad
  Pad Properties:

    alternate-rendition : Alternate Rendition
                          flags: readable, writable, changeable only in
                          NULL or READY state
                          Boxed pointer of type "GstStructure"

    variant             : Variant Stream
                          flags: readable, writable, changeable only in
                          NULL or READY state
                          Boxed pointer of type "GstStructure"
```

Implementation

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- New GStreamer helper `bin` `hlsmultivariantsink`

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- Open MR: !1515

Future work

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- Helper bin on top of `hlsmultivariantsink`

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- Helper bin on top of `hlsmultivariantsink`
  - Generate bit-rate ladder for variant streams
- LL-HLS

Questions

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- Reach out on

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  - email:
    - hello@asymptotic.io
    - sanchayan@asymptotic.io

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