Implementing DASH low latency in FFmpeg

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Open Source Multimedia

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• Open Source multimedia communities
  - VideoLAN: VLC, x264, dav1d
  - FFmpeg: command line utility to process video
  - Xiph, Handbrake, GStreamer
  - Fully and truly open source projects
  - Volunteers
  - Patents and Open Source
What is FFmpeg?

- FFmpeg
  - Swiss Knife of multimedia
  - Everything multimedia processing
  - Libraries and Programs

- Features
  - Decode/Encode/Transcode but also Demux/Mux/Remux
  - Device input and output
  - Filters, scaling and Chroma
  - All platforms
  - Used in VLC, Chrome, Firefox, Linux distributions...
FFmpeg and the ecosystem

- FFmpeg
  - Defacto standard for most of the OTT/cloud encoding
  - Often used with x264, libvpx and other open source libraries
  - Numerous non-open-source libraries plugins for FFmpeg
  - Numerous MAM and cloud APIs are just rewrapping FFmpeg

- Adaptive
  - HLS input and output support
  - Dash input and output support
  - Probably Non-compliant :)}
FFmpeg and Dash-LL project

• Compliance
  - Biggest worry of the project (*dash*+dash-*ll*)
  - Fix MP4/MOV generation
    Introduce some CMAF support and fixes
  - Numerous changes to MP4 `avcc` box
    Producer Reference Time `prft` box
  - Options to set different segment durations for each adaptation set
    and Set chunk/fragment duration in general
  - New profiles, notably for DVB
  - New Latency, Resync elements
  - New Trick Mode
FFmpeg and Dash-LL project

• Server
  - Doing the redirections from ffmpeg to output
  - Python simple server with Nginx https://gitlab.com/fflabs/dash_server

• Clients
  - Dash.Js player
  - VLC player and libVLC SDK
  - Tested on Windows, iOS and Android

https://gitlab.com/fflabs
Dash-LL options

- New Dash options:
  - -seg_duration,
  - -frag_duration,
  - -frag_type,
  - -mpd_profile,
  - -http_opts

- Dash-LL new options:
  - -target_latency,
  - -write_prft,
  - -ldash
As usual, the FFmpeg command line is quite horrible to read:

Graph is hard to show on a command line

```bash
$FF$
- framerate ${INPUT_FPS} \
  -i ${INPUT} \n  -f lavfi -i sine \n  -pix_fmt yuv420p \n  -c:v ${V_CODEC} -b:v:0 500K -b:v:1 200K -s:v:0 960x400 -s:v:1 720x300 \n  -map 0:v:0 -map 0:v:0 \n  -c:a ${A_CODEC} -b:a 96K -ac 2 \n  -map 1:a:0 \n  -use_timeline 0 \n  -utc_timing_url "http://time.akamai.com" \n  -format_options "movflags=cmaf" \n  -frag_type duration \n  -adaptation_sets "id=0,seg_duration=8,frag_duration=2,streams=0,1 id=1,seg_duration=1,frag_type=None,streams=2" \n  -g:v 20 -keyint_min:v 20 -sc_threshold:v 0 -streaming 1 -dash 1 -tune zerolatency \n  -export_side_data prft \n  -write_prft 1 \n  -target_latency ${TARGET_LATENCY} \n  -color_primaries ${COLOR} -color_trc ${COLOR} -colorspace ${COLOR} \n  -f dash \n  ${HTTP_OPTS} \n  ${PROTO}:/${SERVER}:${PORT}/${ID}/${ID}.mpd \n  ${TS_OUT_CMD}
```
Dash-LL command line *(base)*

```
ffmpeg
-framerate ${INPUT_FPS} \
-i ${INPUT} \
-f lavfi -i sine -pix_fmt yuv420p \
-color_primaries ${COLOR} -color_trc ${COLOR} -colorspace ${COLOR} \
-http_opts key_file=${TLS_KEY},cert_file=${TLS_CRT},ca_file=${TLS_CA},tls_verify=1 \
...```

Dash-LL command line *(Dash)*

```
ffmpeg
...
-c:v ${VCODEC} -b:v:0 500K -b:v:1 200K -s:v:0 960x400 -s:v:1 720x300 \ 
-map 0:v:0 -map 0:v:0 \ 
-c:a ${ACODEC} -b:a 96K -ac 2 \ 
-map 1:a:0 \ 
-f dash \ 
-use_timeline 0 \ 
-utc_timing_url "http://time.akamai.com" \ 
-frag_type duration \ 
${PROTO}://${SERVER}:${PORT}/${ID}/${ID}.mpd ...
```
Dash-LL command line (Dash-LL)

```bash
ffmpeg
...
-format_options "movflags=cmaf" \ 
-adaptation_sets "id=0,seg_duration=8,frag_duration=2,streams=0,1 id=1,seg_duration=1,frag_type=none,streams=2" \ 
-g:v 20 -keyint_min:v 20 -sc_threshold:v 0 \ 
-export_side_data prft -write_prft 1 \ 
-streaming 1 \ 
-ldash 1 \ 
-tune zerolatency \ 
-target_latency 3.5
```
Dash-LL documentation

Documentation
- https://ffmpeg.org/ffmpeg-formats.html#dash-2
- 45 different options for Dash generation

Everything is in FFmpeg master
- Mailing lists
- IRC
- Check out the code

Demos
- Multi-codec demo
Questions

• Questions to me

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