MOTION SPELL

GStreamer Meets GPAC

Enhancing GStreamer's Capabilities through GPAC Integration

#DASH #HLS #CMAF #CENC
#SCTE35 #LowLatency #AV1
#VVC #ProRes #VR

About

Brief History and Background, Deniz Ugur and Motion Spell

- Developer, Open Source and Open Standard advocate
- Contributor to GPAC
- Software Architect at Motion Spell

Overview of GPAC

- Open Source Multimedia Framework focused on modularity & standard compliance
- Open source since 2003. ~800kloc; $14m in investment
- Large international community of 80+ contributors
- A leader in packaging, it provides tools to process, inspect, package, stream, playback and interact with media content
- Lead by a team of experts, with roots in research & standardization
- Licensed under the GNU LGPLv2.1 or later

Motion Spell - Professional services provider based on GPAC

- Consulting, custom integrations & developments
- Training and support and solutions based on GPAC (conformance, subtitling)
- Motion Spell is also the exclusive commercial licensor of GPAC.

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What We'll Cover

Introduction to GPAC:

- What is GPAC?
- Who's using GPAC?

Working with GPAC Filters:

- Building media pipelines
- Peek inside how it is working

Interoperability with GStreamer:

- What do we address?
- How is it working?
- Examples
- Current Difficulties

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Introduction to GPAC

What is GPAC?

A multimedia framework with tools to:

- **process**
- **inspect**
- **package**
- **stream**
- **playback**
- **interact**
  with media content

Codec Support Handles formats like MPEG audio, AC3, E-AC3, Opus, FLAC, H264|AVC, HEVC, VVC, AV1, VP9, and Theora.

Subtitle Support Integrates with WebVTT, TTML, 3GPP/Apple Timed Text, and more.

Encryption Supports CENC, PIFF, HLS, and ISMA for secure media distribution.

Container Formats Compatible with MP4, MOV, but also AVI, MPEG, OGG, MKV, etc.

Streaming Protocols Works with MPEG-TS, RTP/RTSP, HTTP, HLS, DASH, Multicast ABR (ATSC3, DVB, ROUTE, FLUTE).

And many more features...

Introduction to GPAC

Who's using GPAC?

It is mostly used by:

- Enthusiasts
- Academia (students, researchers)
- Media and Entertainment Technology Companies
- Standardization bodies

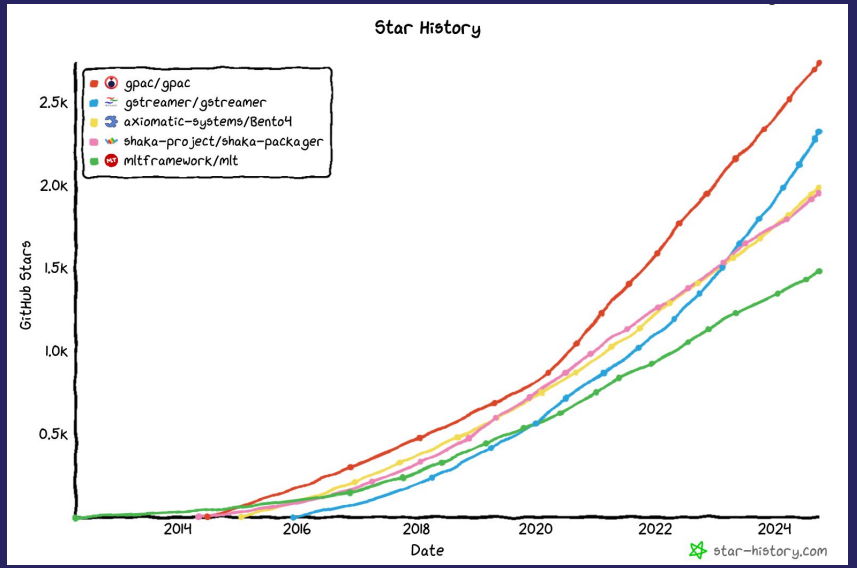
Sponsors & Customers

Introduction to GPAC

Who's using GPAC?

It is mostly used by:

- Enthusiasts
- Academia (students, researchers)
- Media and Entertainment Technology Companies
- Corporate Users



GitHub Star History

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Working with GPAC Filters

Building media pipelines

- GPAC aims to be simple for trivial tasks
- Intuitive and stable syntax
- Makes your life easier: identifiers, aliases, embedded help
- GUI (to be announced)

```
# Source Inspection
gpac -i source.mp4 inspect
```

```
# Multiplexing
gpac -i video.mp4 -i audio.aac -o dst.mp4
```

```
# Encoding
gpac -i source.mp3 enc:c=aac:b=100k -o dst.mp4
```

```
# Encryption
gpac -i source.mp4 cecrypt:cfile=drm.xml -o live.mpd
```

```
# DASH/HLS Generation
gpac -i source.mp4 -i source2.mp4 -o live.m3u8
gpac -i source.mp4 -i source2.mp4 -o live.mpd
```

```
# Time Modification (delay or increase speed)
gpac -i source.mp4 restamp:delay_a=2/10 -o dst.mp4
gpac -i source.mp4 restamp:fps=-11/10 -o dst.mp4
```

More examples at wiki.gpac.io/oneliners

Working with GPAC Filters

Peek Inside

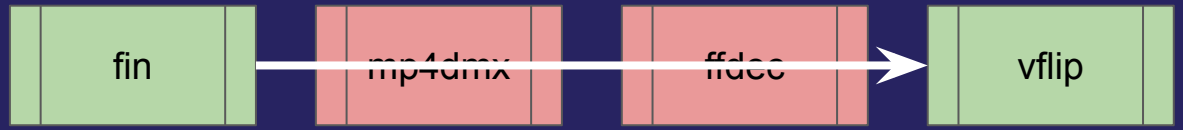
Consider a simple example of flipping a video file

```
gpac -i media.mp4 vflip c=avc -o output.mp4
```

input filter encoder output

Working with GPAC Filters

Peek Inside Contd.



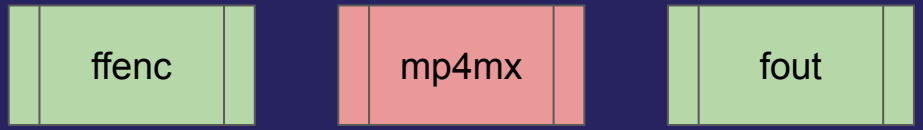
(1) User specifies input as “media.mp4”

(2) User wants to flip the video

(3) gpac loads a demuxer and decoder

(4) User wants to encode and output the file

(5) gpac loads a multiplexer



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Interoperability with GStreamer

What do we address?

- GPAC customers asking for GStreamer integration
- We share the same core values of open-source ❤️
- Great opportunity to cross reach
- Still in infancy: focus on what people ask for

Community Merger A lot of expertise behind both frameworks. Communities can benefit from each other.

Familiarity Targeted for people familiar with using gpac but used to the APIs of GStreamer.

Custom Integrations GStreamer is custom-first, gpac is command-line first. Best of both worlds.

Extensibility gpac enables developers to create custom filters with handful of lines of code.

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Interoperability with GStreamer

How is it working?

Functions as a sub-session in GStreamer

gst-launch-1.0 videotestsrc ! x264enc ! h264parse ! **gpac graph=-o out.mpd**

gst-launch-1.0 videotestsrc ! **gpac graph=mp4mx** ! filesink location=out.mp4

- Accepts anything
- Rejects only if caps don't have a translation

- Outputs everything
- (WIP) Negotiates caps

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Interoperability with GStreamer

Examples

```
gst-launch-1.0 -v filesrc location=test.obu ! video/x-av1 ! gpac_sink graph= \
    -o output_enc_nofrag.mp4:fps=24000/1001:moovts=-1:deps=1
```

```
gst-launch-1.0 -v filesrc location=output_enc_nofrag.mp4 ! qtdemux ! gpac_sink graph= \
    -o out.mpd:segdur=1000:cues=cues.xml:mvex=1:tfdt_traf=1:nofragdef=1:straf=1:ssix=1
```

- **moovts** Sets the time scale
- **deps** Add samples dependencies information
- **mvex** Set mvex boxes after trak boxes
- **tfdt_traf** Force tfdt box in each traf
- **nofragdef** Disable default flags in fragments
- **straf** Use a single traf per moof
- **ssix** Create ssix box when sidx box is present

That's just 4% of the options

mp4mx and dasher combined

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Interoperability with GStreamer

Current Difficulties

- Mostly timing related issues
- Minor differences in some boxes
  - **btrt**: Max Bitrate
  - **mvhd, mdhd, tkhd**: Duration
  - …

```
AV1 Basic    FAIL
    └── packaged.ismv: FAIL (2 differences)
```

Detailed comparison for packaged.ismv

Box	Property	Expected	Actual	Occurrences
BitRateBox	maxBitRate	1604560	563337	1
BitRateBox	avgBitRate	563336	563337	1

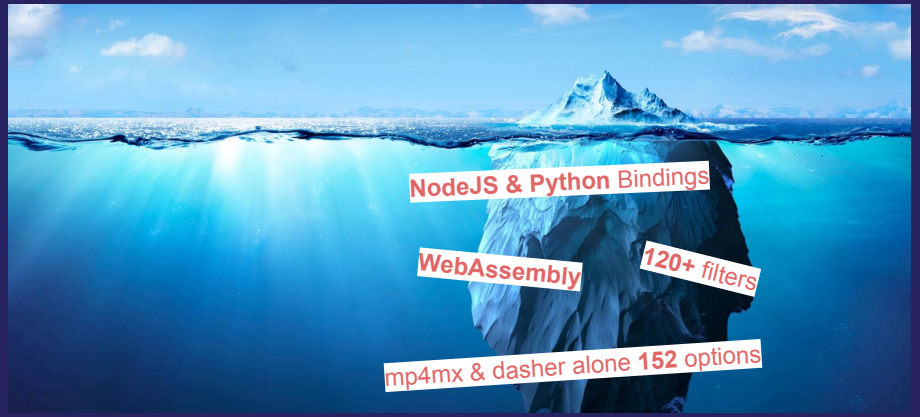
```
MP4 AACLC    FAIL
    └── output.mp4: FAIL (~7 differences)
```

Detailed comparison for output.mp4

Box	Property	Expected	Actual	Occurrences
MovieHeaderBox	TimeScale	1000	600	1
MovieHeaderBox	Duration	10000	5990	1
TrackHeaderBox	Flags	3	1	1
TrackHeaderBox	Duration	10000	5990	1
MediaHeaderBox	Duration	480000	479232	1
TimeToSampleBox	EntryCount	2	3	1
TimeToSampleEntry	SampleCount	468	1	1

Recap

- GPAC is a renowned multimedia framework
- GPAC and GStreamer are compatible in terms of how they operate



More Info

www.gpac.io

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