GPAC 1.0 Overview

http://gpac.io
What is GPAC?

- **Open-Source Multimedia Framework**
- **Our lab’s research platform**
- **MP4Box**
  - MP4/ISOBMFF packager
  - DASH segmenter
  - MPEG-4 BIFS & LASeR encoder
  - Dump and analysis

- **Osmo4/MP4Client**
  - A/V/Text/2D/3D interactive renderer
  - JavaScript for SVG/BIFS/VRML (SpiderMonkey)
  - Various network stacks (plugins)
  - Various decoders (plugins)
GPAC History

- 2001: first lines of libisomedia and player
- 2003: First open-source GPAC release
  - “The only Open-Source MPEG-4 Systems player”
- 2005: GPAC goes LGPL
- 2005-2017
  - 25+ EU and French R&D projects
  - Ever-increasing scope
    - Broadcast, mobile broadcast
    - Digital Radio
    - DataCast (EPG, Apps, (e)MBMS)
    - IP Streaming, OTT
    - Content Protection
    - 3D, Auto-stereo displays, 360 VR
    - Scalable coding
    - Hybrid broadcast/broadband
    - UHD, HFR, HDR
    - Interactivity (SVG, MPEG-4 LASER, Widgets, …)
    - Image formats (HEIF)
    - Ad Insertion
    - …
GPAC after 15 years

- Architectural nightmare

**MP4Box**
**MP4TS**
**DashCast**
**Osmo4 MP4Client**

Authoring:
- Dasher
- MP4 write
- RTP Streamers
- TS Muxer
- Media Importers

Playback:
- 2D/3D Compositor
- Dash Client
- MP4 read
- TS Demux
- RTP Client

**Common tools**
libgpac

Demux + Network Plugins *(Media Importers)*

Decoder Plugins
Rearchitecture required!

- **Get rid of**
  - Duplicated functionalities
  - Inconsistent configuration and documentation

- **Do not modify**
  - MP4Box and MP4Client usage
  - Existing APIs
  - Binary results for packagers

- **Add**
  - User-defined media pipelines
  - Many tools we had in mind for 10+ years!
GPAC 1.0 Streaming Core Overview

- **GF_FilterSession**
  - Task-based scheduler
    - RT when desired/required
  - Memory GC, buffer management
  - [0,N] threaded, lock-free queues
  - Dynamic graph resolution
  - Blocking/ non-blocking modes
  - Events management

- **GF_FilterPacket**
  - Reference-counted processing block
    - full/partial frame, file …
  - Associated data
    - Managed (recycled) memory
    - Shared (filter internal) memory
    - interface object (HW codecs)
  - Static properties (timestamps, size, framing)
  - Dynamic properties (CENC info, user-defined, …)

- **GF_Filter**
  - Same API for all types
  - I/O capabilities
  - Single-threaded
  - Dynamic stream reconfiguration
  - Defines its own options, documentation
  - Can load input or output filters
    - HAS client, segmenter

- **GF_FilterPid (PIDs)**
  - Data link between filters
  - Packet I/O
  - Blocking/buffering management
  - Dynamic properties
    - codec, samplerate, …
  - User-assignable properties
    - ServiceID, custom…
High-level impact on GPAC

- **New application “gpac”**
  - Generic pipeline assembler (command-line)

- **MP4Box**
  - *GF_FilterSession* for importers, exporters, encryption, fragmentation and dashing
  - AV RTP Streamer removed (use *gpac*)

- **Players (MP4Client/Osmo4)**
  - All demux and decoder plugins moved to *GF_Filter*
  - Player ⇔ *GF_FilterSession* running the compositor filter
  - AVI and image export removed (use *gpac*)

- **MP42TS and DashCast**
  - Removed (use *gpac*)
Features …

I/O
- Pipe (Linux/OSX/Windows) in/out
- Socket (UDP, TCP, Unix Domain) in/out
- File in/out
- HTTP in/out/server
- RTP in/out and RTSP server

Raw Data
- Most YUV and RGB formats
- All PCM formats

Compositor Filter
- SVG/BIFS/VRML graphics in a filter chain
... features ...

**FFmpeg Support**
- Demux and Mux (*libavformat*)
- **Encoders** and decoders (*libavcodec*)
- Grabbers (*libavdevice*)
- Simple and complex filters (*libavfilter*)
- Direct mapping of options

**Distributed Processing**
- Internal serialization format *GSF*
- Compatible with all GPAC I/O (file, pipe, socket, HTTP)
- AES-128 CBC encryption
- *WiP*: *events*
... features ...

- **JavaScript Filters**
  - QuickJS (ES2020)
  - Complete JS bindings of the filter API
  - EVG (GPAC 2D and text software rasterizer) API
  - XmlHttpRequest
  - WebGL 1.0 Core
  - More APIs to come
… features …

- **Encryption**
  - On-the-fly encrypt/decrypt
  - HAS Segment-based encryption

- **More HEIF support**
  - Batch conversion HEIF->JPG/PNGs trivial

- **VR**
  - HEVC tiles splitting and merging

- **Inspection**
  - With basic media analyzer
  - Anywhere in the graph

- **HAS**
  - HLS and dual DASH/HLS output

- **ISOBMFF customization**
  - Generic box insert/delete in movie and movie fragments

- **GPAC 0.8**
  - AV1, VP9, ATSC 3.0 demux, 360 video, HW decode, …
… features !

- Audio and Video output
  - Compositor no longer required
- M2TS split
  - Split programs without demultiplexing
- Video cropper
  - Zero memory copy mode
- Source concatenator
  - Raw or compressed inputs
- Misc
  - Video flip
  - Audio resampler
  - Video rescaler (FFMPEG for now)
  - A/V rewinder (experimental)
  - …
Some examples

- **Output file templating**
  
gpac -i collection.heif -o dump_$ItemID$.jpg:clone
  gpac -i source_ts tssplit @#ServiceID= -o prog_$GINC(10,2).ts

- **Multi-dump of h264 RTP**
  
gpac -i session.sdp -o dump.264 -o dump.mp4 -o dump.ts -o dump.mpd

- **Encoding**
  
gpac -i raw.yuv:size=1280x720:fps=30 enc:c=avc:b=1m -o output.mp4

- **Dual HLS and DASH**
  
MP4Box -dash 1000 -profile onDemand source -o output.mpd:dual

- **Distributed processing**
  
gpac -i source enc:c=avc:b=1m -o pipe://test:ext=gsf:mkp &
  gpac -i pipe://test:ext=gsf -o dest.mp4

- **Analyzing**
  
gpac -i source inspect:deep:analyze
Tests and coverage

Current view: top level

Test: 0.8.0-rev167-gcccb740f-master
Date: 2020-01-20 14:28:28

- Lines: 65340
- Total: 271168
- Coverage: 24.1%
- Functions: 3702
- Total: 13042
- Coverage: 28.4%

- Per-commit build and tests
  - Status: [https://buildbot.gpac.io](https://buildbot.gpac.io)
  - Tests: [https://tests.gpac.io](https://tests.gpac.io)

- New test suite repo
  - [https://github.com/gpac/testsuite](https://github.com/gpac/testsuite)

Current view: top level

Test: 0.9.0-DEV-rev3158-g8d3af941-filters
Date: 2020-01-21 23:48:07

- Lines: 218251
- Total: 287533
- Coverage: 75.9%
- Functions: 12051
- Total: 13004
- Coverage: 92.7%
Documentation

- **Automatic Generation**
  - http://wiki.gpac.io
  - ‘-h’ and man pages

- **HOWTOs**
  - http://wiki.gpac.io/Howtos
  - WiP …

- **Improved DEV doc for libgpac**
  - http://doxygen.gpac.io
What’s next

- **Final merge and release 1.0 !**
  - March/April 2020

- **On-going work**
  - Automated Fuzzing

- **Future roadmap**
  - More HW codecs
  - Remote session monitoring
  - Higher level APIs
  - …