



Institut
Mines-Télécom



MP4Box.js a GPAC development

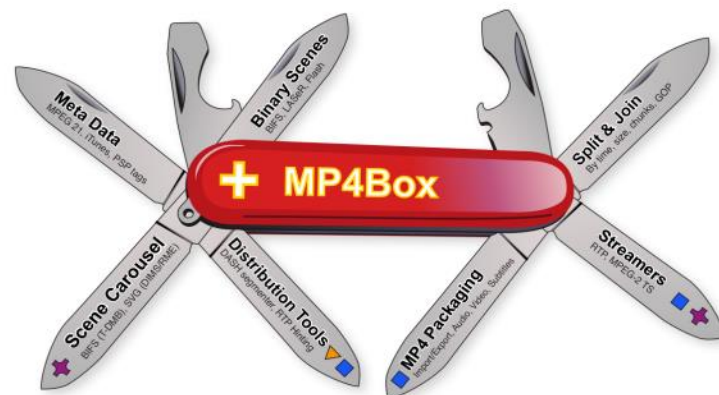
Cyril Concolato



For those who don't know GPAC

■ Multimedia Packager: MP4Box

- World-wide reference for **MP4** file manipulations and MPEG-DASH generation
- Many other formats and usages: encryption, real-time streaming, graphics encoding, ...



■ Multimedia Player and Browser

- Many protocols: including the latest **HTTP adaptive streaming technologies**
- Any audio/video codec: including **MPEG-HEVC/SHVC**
- **2D/3D** graphics rendering
- Interactive support with **JavaScript**

■ Open Source

- 15 years old, C code, LGPL
- Hosted on GitHub

Research-oriented

- Presence in major multimedia events and conferences
- 100+ academic references



MP4Box.js

■ JavaScript library to process MP4 files

- BSD-3 licensed
- Modular
- <https://github.com/gpac/mp4box.js>

■ Environments

- Browsers (Firefox, Chrome, IE/Edge, Safari)
- Node.js

■ Applications

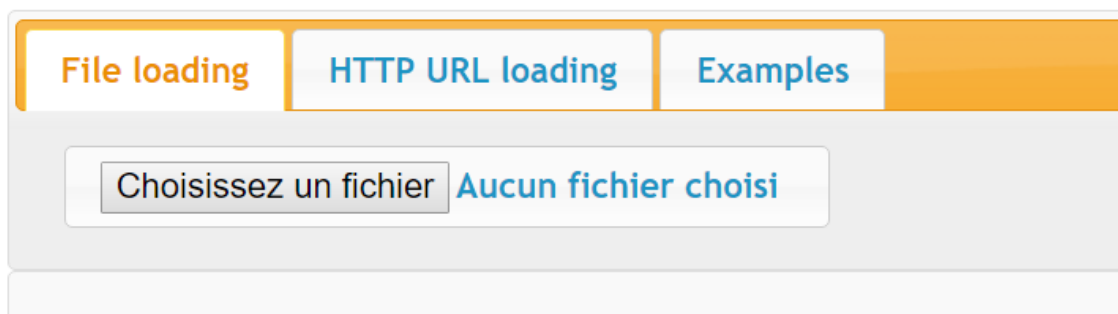
- MP4 Analyzer
- MP4 Player
- MP4 Data extractor
- MP4 Remuxer: On-the-fly fragmentation



Online MP4 Analysis

MP4Box.js

ISOBMFF Box Structure Viewer (see also [File Player](#))



- **View general file info**
 - Duration, number and types of tracks, number of samples
- **Inspect box hierarchy and property values**
- **Inspect sample information**
- **Inspect item information**



General File Information

Movie Info

File Size	0 bytes
Brands	isom,isom
Creation Date	Tue Apr 15 2014 20:24:40 GMT+0200 (Paris, Madrid (heure d'été))
Modified Date	Tue Apr 15 2014 20:24:40 GMT+0200 (Paris, Madrid (heure d'été))
Timescale	600
Duration	360002 (0:10:00.003)
Bitrate	0 kbps
Progressive	true
Fragmented	false
MPEG-4 IOD	true

Video track(s) info

Track ID	Track References	Alternate Group	Timescale	Media Duration	Number of Samples	Bitrate (kbps)	Codec	Language	Kind	Track Width	Track Height	Track Layer	Width	Height
2	none	0	25000	15000000 (0:10:00.000)	15000	47	avc1.42c00d	und	-	320	180	0	320	180

Audio track(s) info

Track ID	Track References	Alternate Group	Timescale	Media Duration	Number of Samples	Bitrate (kbps)	Codec	Language	Kind	Track Width	Track Height	Track Layer	Sample Rate	Channel Count	Volume
3	none	0	44100	26460160 (0:10:00.003)	25840	16	mp4a.40.2	und	-	0	0	0	44100	1	1

Subtitle / Text track(s) info

Track ID	Track References	Alternate Group	Timescale	Media Duration	Number of Samples	Bitrate (kbps)	Codec	Language	Kind	Track Width	Track Height	Track Layer
4	none	0	1000	600000 (0:10:00.000)	600	0	wvtt	und	-	320	180	0



Simple Box Tree View

Select Example:
Multiplexed Audio/Video/Subtitle (unfragmented, AVC+AAC+WebVTT)

Loading Completed!

Movie View Box View Sample View Item View

Tree View Partition View Treemap View

Box Tree View

- ftyp
- moov
 - mvhd
 - iods
 - trak
 - tkhd
 - mdia
 - mdhd
 - hdlr
 - minf
 - trak
 - trak
 - mdat
 - free

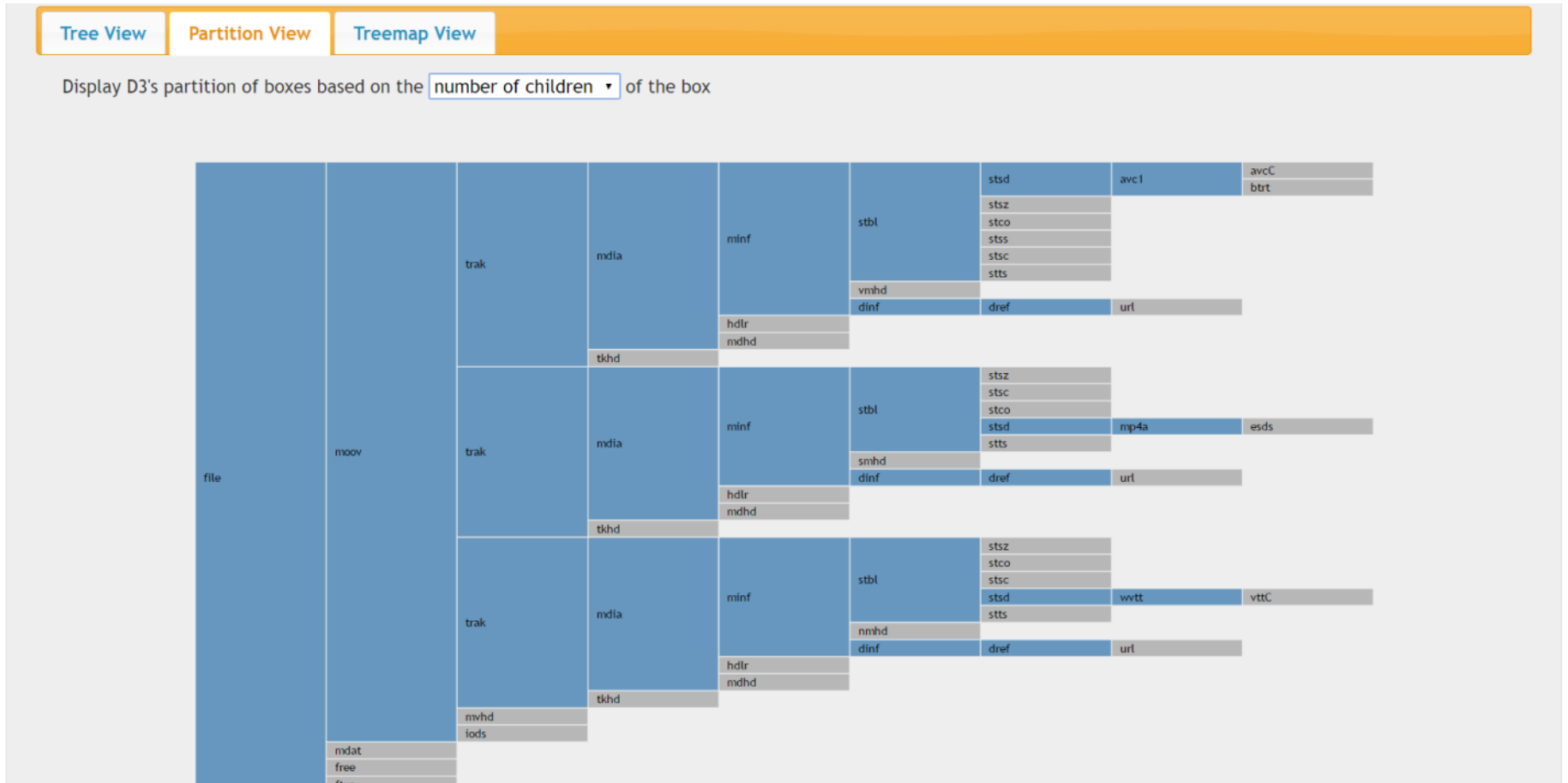
Box Property View

Property name	Property value
type	hdlr
size	124
flags	0
version	0
handler	vide
name	counter-10mn_I25_320x180_48kbps_baseline.264:dur=600 - Imported with GPAC 0.4.6-DEV-rev3915



Graphical Box Views

■ Integration with D3.js



Basic Sample Information

Select Example:

Multiplexed Audio/Video/Subtitle (unfragmented, AVC+AAC+WebVTT)

Load

Loading Completed!

Movie View

Box View

Sample View

Item View

Track ID: 3

Codec: mp4a.40.2

Sample range: [0-10]

Sample Table

Sample Graph

Sample Map

Sample number	DTS	CTS	RAP	Offset	Size
0	0(0:00:00.000)	0(0:00:00.000)	true	197052	104
1	1024(0:00:00.023)	1024(0:00:00.023)	true	197156	92
2	2048(0:00:00.046)	2048(0:00:00.046)	true	197248	6
3	3072(0:00:00.069)	3072(0:00:00.069)	true	197254	36
4	4096(0:00:00.092)	4096(0:00:00.092)	true	197290	31
5	5120(0:00:00.116)	5120(0:00:00.116)	true	197321	48
6	6144(0:00:00.139)	6144(0:00:00.139)	true	197369	38
7	7168(0:00:00.162)	7168(0:00:00.162)	true	197407	36
8	8192(0:00:00.185)	8192(0:00:00.185)	true	197443	36
9	9216(0:00:00.208)	9216(0:00:00.208)	true	197479	47



Sample Interleaving Layout

Sample Table

Sample Graph

Sample Map

0																																																																							
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80								120								160								200								240								280								320								40								80							
320				360				400				440				480				520				560				600				640				680				720				760				800				840				880				920											
185	208	232	255	278	301	325	348	371	394	417	441	464	487	0	1000				520				23				69	92	116	139	162																																								
600				640				680				720				760				800				840				880				920																																							
920				960				510				534	557	580	603	626	650	673	696	719	743	766	789	812	835	859	882	905	928	952																																									
952	975	2000																																																																					
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1000																																																																							
1080								1120								1160								1200								1240								1280								1040								1080															
1320				1360				1400				1440				998				1021				1068				1091	1114																																										
	1137	1160	1184	1207	1230	1253	1277	1300	1323	1346	1369	1416	1439	1462	3000	1480				1520				1560																																															
1560				1600				1640				1680				1720				1760				1800				1840																																											
1840				1880				1920				1486				1509	1532	1555	1578	1602	1625	1648	1671	1695	1718	1741	1764	1787	1811	1834																																									
1857	1880	1904	1927	1950	4000	1960				2000																																																													
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2200				2240				2280				2320				2360				2400																																																			
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2440				2480				2520				2560				2600				2640				2680																																															
2680				2720				2760				2800				2840				2880																																																			
2461	2484	2507	2530	2554	2577	2600	2623	2647	2670	2693	2716	2739	2763	2786	2809	2832	2856	6000	2920				2960																																																
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3880				3920				3960				4000																																																											

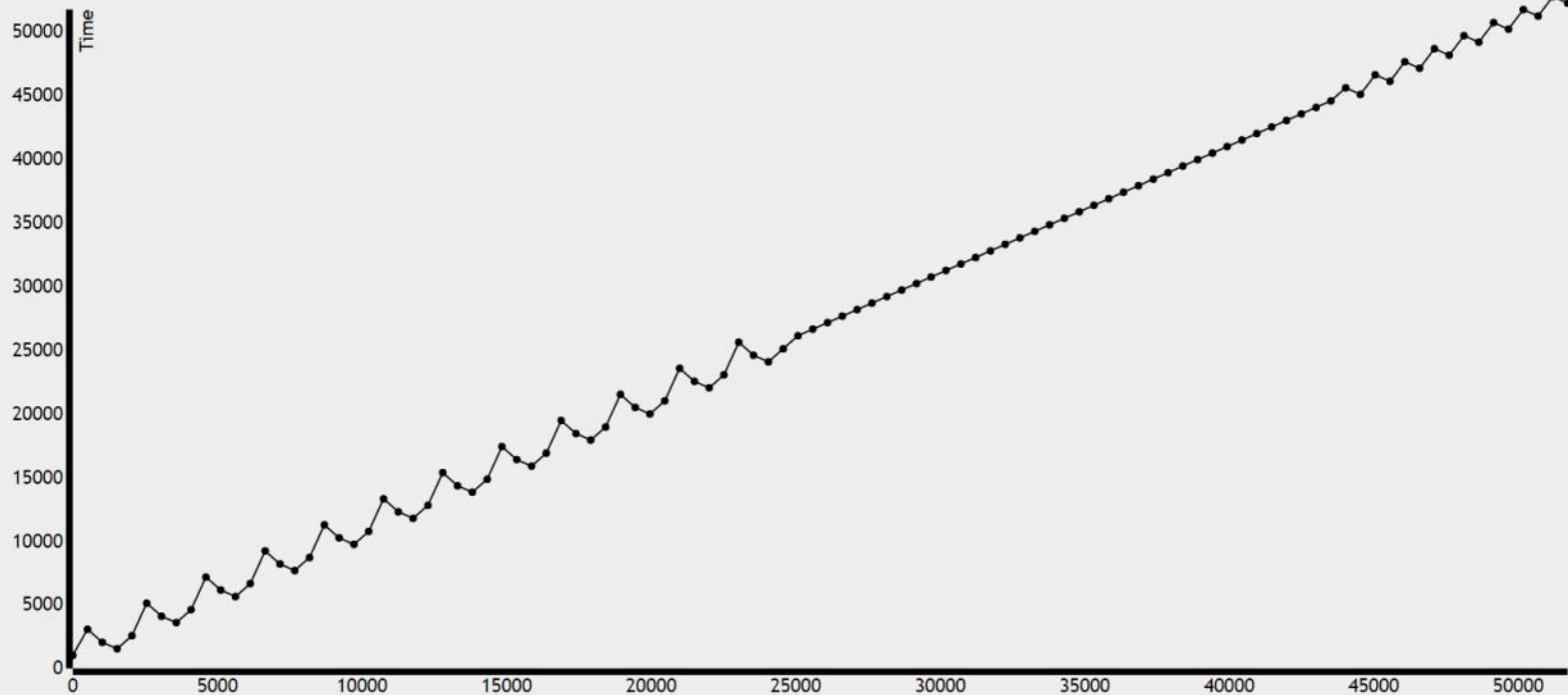


Timestamp Inspection

Sample Table

Sample Graph

Sample Map



MP4Box.js Service Worker

■ W3C Service Workers

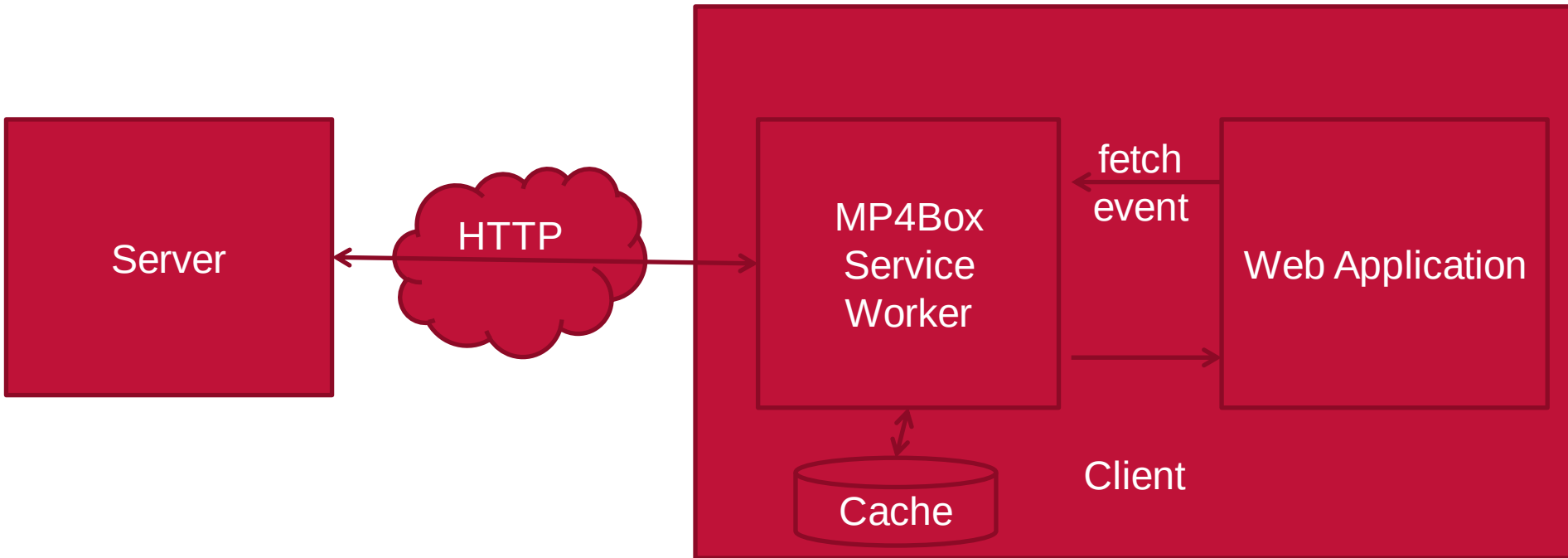
- JavaScript-based Browser Threads
 - For network-related tasks
- Site/Domain bound
 - Thread is active if at least one tab for a registered domain is active
- Can intercept and modify page/server communications
 - All fetch events go through the SW
 - E.g. caching for offline usage

■ MP4Box-SW

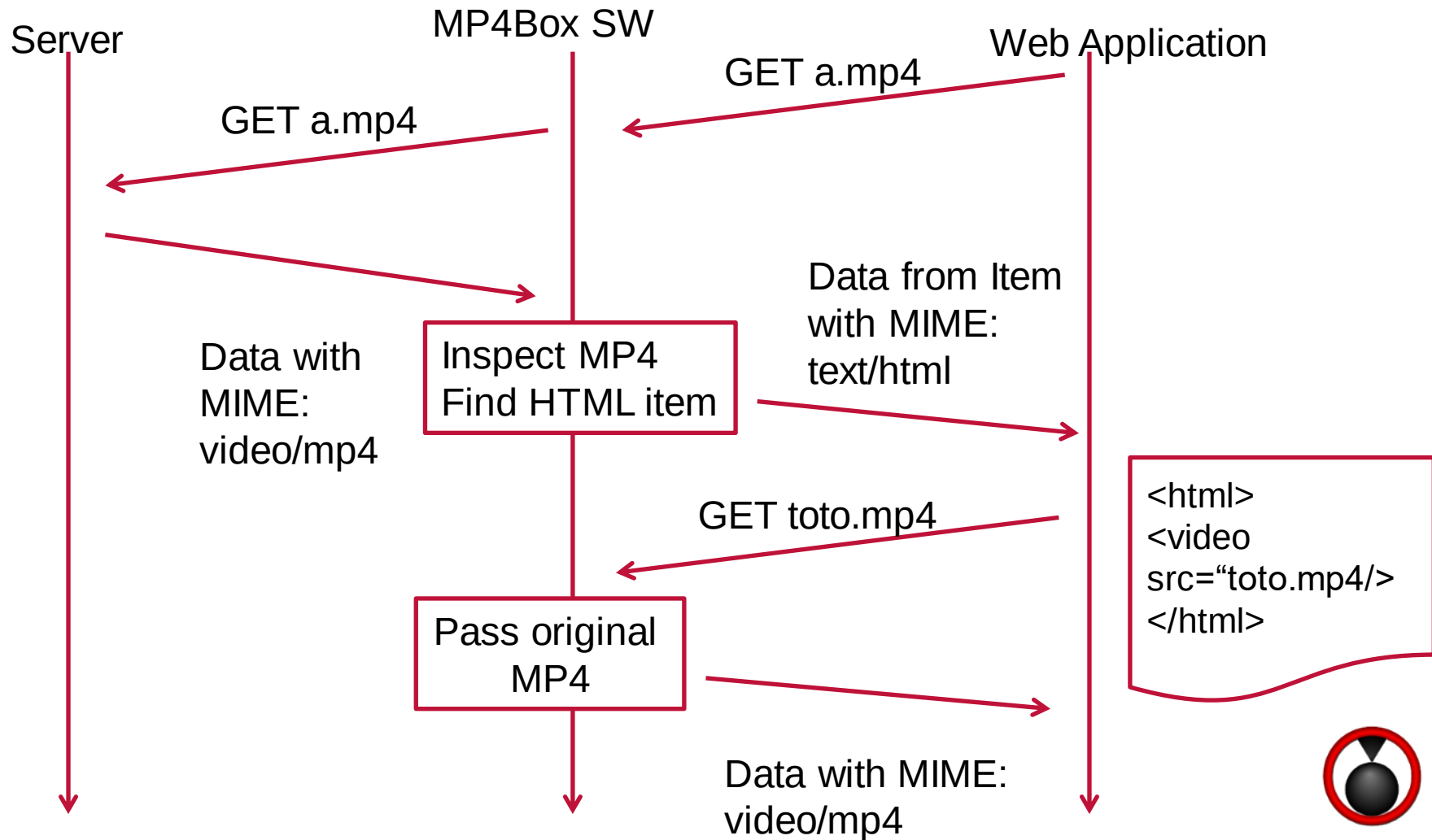
- Run MP4Box as a service worker
 - For on-the-fly MP4 file manipulations
- No MP4Box code in the web page



MP4Box Service Worker Architecture

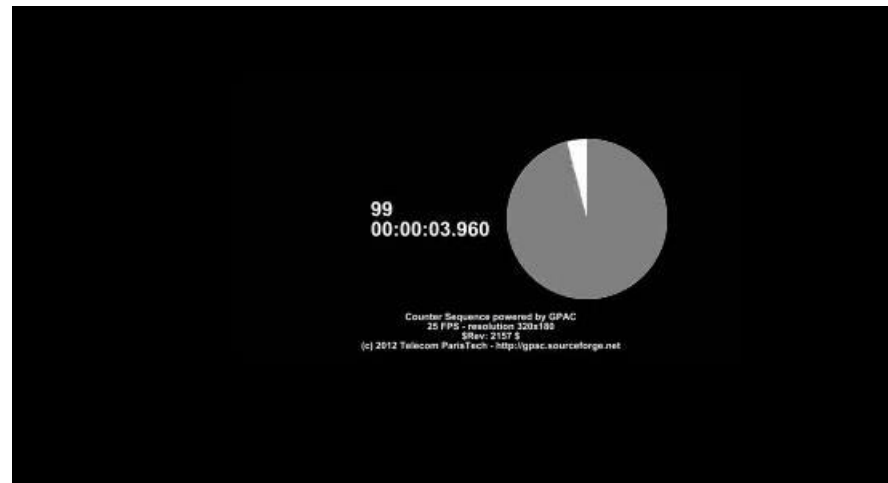


MP4Box SW Sequence



MP4Box SW Basic Example

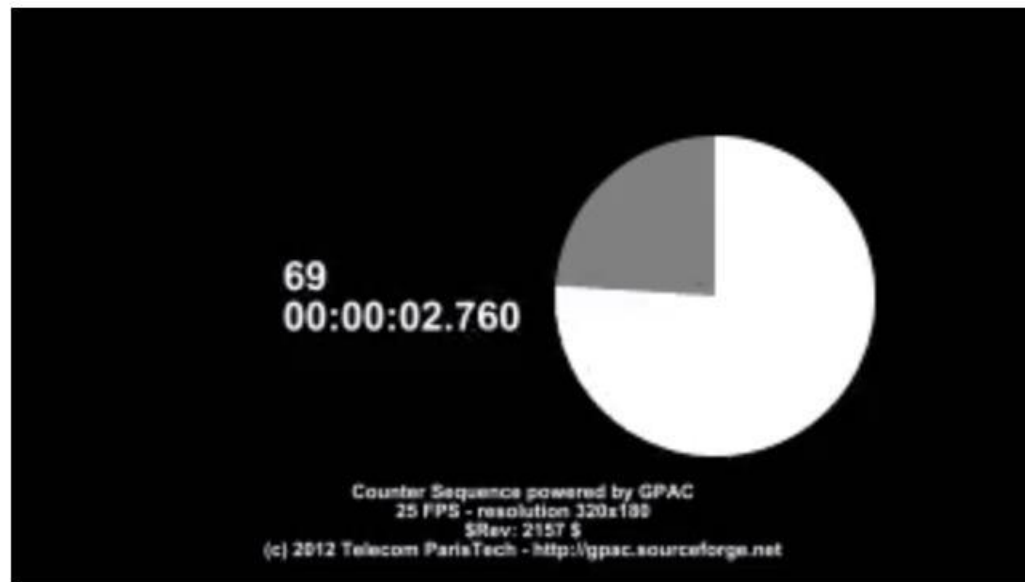
Without Service Worker: simple video



MP4Box SW Basic Example

With Service Worker: video embedded HTML / CSS

This is an HTML page embeded in the MP4 file



TELECOM
ParisTech

MP4Box SW Advanced Example

Without Service Worker: simple video



TELECOM
ParisTech

MP4Box SW Advanced Example

With Service Worker: video and synchronized graphics and text



Next play:
Previous move:
Outcome odds:
This board also appeared in:

white
3. Nc3 ... d5
W: 33.9% D: 41.5% B: 24.6%
[Kramnik vs Kasparov, 2000 \(1-0\)](#)



Chess Demo : View of Packaged Items

Movie View Box View Sample View Item View						
ID	Name	Type	Primary Protected		Byte ranges	
1	index.html	text/html	Yes	No	[76588-77406]	
2	assets/chess_script.js	text/javascript	No	No	[77407-77934]	
3	assets/script.js	text/javascript	No	No	[77935-81287]	
4	assets/cues.vtt	text/vtt	No	No	[81288-85510]	
5	assets/chessboardjs/www/css/chessboard.css	text/css	No	No	[85511-86888]	
6	assets/chessboardjs/www/js/chessboard.js	text/javascript	No	No	[86889-132722]	
7	assets/chessboardjs/www/js/jquery-1.10.1.min.js	text/javascript	No	No	[132723-225745]	
8	assets/chessboardjs/www/js/jquery.color.min.js	text/javascript	No	No	[225746-232511]	
9	assets/chessboardjs/www/js/json3.min.js	text/javascript	No	No	[232512-239881]	
10	assets/chessboardjs/www/img/board-background.png	image/png	No	No	[239882-240418]	
11	assets/chessboardjs/www/img/chesspieces/wikipedia/bB.png	image/png	No	No	[240419-241823]	
12	assets/chessboardjs/www/img/chesspieces/wikipedia/bK.png	image/png	No	No	[241824-244832]	



Relative links are preserved in the MP4



MP4Box.js Data Extraction

■ Retrieve sample data for processing in JS

- For media types not natively supported by the browsers
 - In particular when stored in MP4 files (e.g. WebVTT in MP4, TTML in MP4)
 - Or for processing in JS (metadata, exotic media data)

■ Retrieve only samples of interest

- Ex: Display RAP snapshot of an video



Processing of MP4/HEVC in Browsers

- Convert HEVC RAP samples as BPG images
- Use BPG JS decoder for display

MP4Box.js

HEVC image extraction from MP4 and display as BPG

File upload

HTTP URL input

Select or enter an HTTP URL to an MP4-HEVC or BPG resource

Enter URL:

9%



0:00:00.000



0:00:02.000



0:00:04.000



0:00:06.000



0:00:08.000

MP4Box.js – Media Source Extension

- **MSE requires MP4 fragmentation**
 - Many non-fragmented MP4 out-there
- **MP4Box.js can do on-the-fly, progressive fragmentation**
 - Use AJAX to download non-fragmented MP4 using HTTP byte ranges
 - Push downloaded data to MP4Box.js
 - Get fragmented data from MP4box.js
 - Push fragments to MSE
- **Fragmentation and sample extraction at the same time**
 - Ex: Processing of non-progressive MP4 with WebVTT track
- **Support for large files (tested with 7GB)**
 - Configurable memory management



MP4Box.js Sample Player

MP4Box.js

Playing any MP4 in your browser (see also [File Analyzer](#))



Download Completed!

Player Controls

Media Info

Download Settings

Segmentation/Extraction Settings

Debug Settings

Instructions & Notes

Select or set URL:

Multiplexed Audio/Video/Subtitle (unfragmented, AVC+AAC+WebVTT)

URL: ./mp4/avw.mp4

Download/Playback Controls

Play

Load Media Info

Add and Initialize All Source Buffers

Initialize Source Buffers

Load Media Data & Play

Stop Media Download

Reset

Playback Rate 1



Node JS tools

■ Early developments

- Lots of things still to be done

■ Examples

- File Information (like MP4Box –info)
- Get MIME Type with “codecs” and “profiles” parameter
 - Ex: for integration in NodeJS-based HTTP servers
- Fragmentation

```
node fragment.js <inputfilename> <trackid> <nbSamplesPerSeg> <outputfilename>
```



MP4Box.js Roadmap

GPAC is hiring!

■ General project improvement

- Testing: more qunits
- Benchmark for Bit/Byte manipulation libraries

■ Improve fragmentation

- Better performance on Firefox/Edge

■ Improve HEVC support

- Benchmark JS decoders
- Support for tiled video

■ Improve Service Worker

- Support for recent W3C Streams API in Chrome Canary

■ Requested features so far

- More input formats: MKV, raw H264

■ Improve player

- Package player as single JS for easier integration

■ Improve NodeJS support



Links

■ Player:

- <http://download.tsi.telecom-paristech.fr/gpac/mp4box.js/>

■ File analyzer:

- <http://download.tsi.telecom-paristech.fr/gpac/mp4box.js/filereader.html>

■ HEVC image viewer:

- <http://download.tsi.telecom-paristech.fr/gpac/mp4box.js/hevcimageviewer/>

■ Service Worker:

- <https://gpac.github.io/mp4box-sw/>





**Thank you
Questions!**

GPAC

#industry #mp4box #osmo4 #broadcast
#mpeg #mp4 #dash #hevc

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