MATROŠKA Low Latency Streaming

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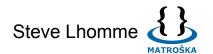
{ Origin Of MATROŠKA }

- Created in Open communities (IRC, mailing lists, Doom9)
- Mix of AVI, Ogg, XML, Unicode, Semantic Web (2002 buzzwords)
- W3C inspired (open, royalty free)
- Long term storage (designed for 10+ years)
- Low overhead
- Streaming Friendly (continuous stream, progressive download p2p)
- Adopted by Google/Mozilla for WebM
- A.K.A. .mkv files



{ IETF CELLAR Group }

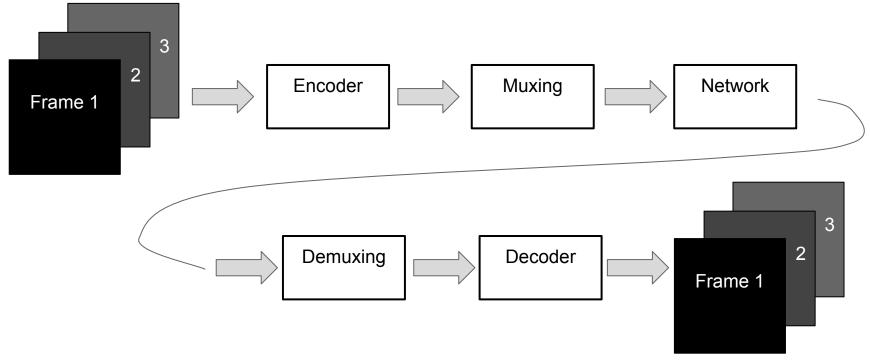
- Codec Encoding for LossLess Archiving and Real-time transmission
- EBML and MATROŠKA documentations
- 13 contributors
- +300 commits for each
- Started in 2015
- Also handles FFV1 and FLAC standardization



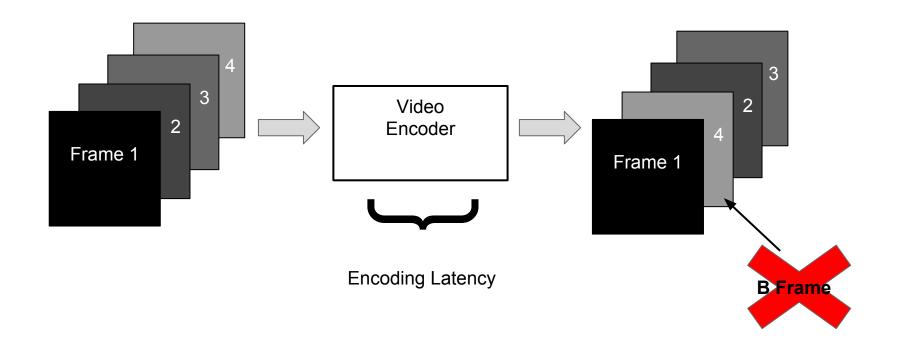
{ What is Latency ?}

Wikipedia:

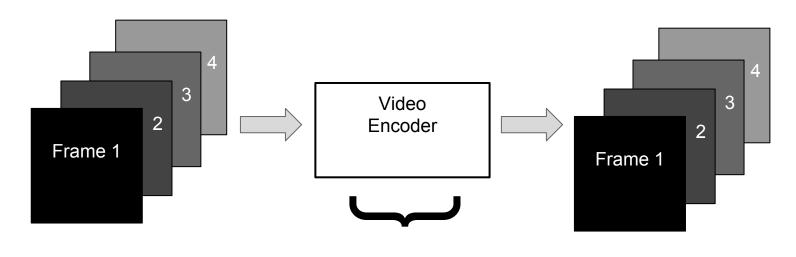
Latency is a time interval between the stimulation and response, or, from a more general point of view, a time delay between the cause and the effect of some physical change in the system being observed.



{ Video Encoding }



{ Video Encoding }



Encoding Latency

{ MATROŠKA File Structure }

File structure

Не	Meta	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster	Cues	Chapters	Tags
ad	Seek	A+V	A+V	A+V	A+V	A+V	A+V			
er									i	
								l. 		

Live stream structure

He	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster
ad	A+V	A+V	A+V	A+V	A+V	A+V
er						

{ WebM DASH }

Live stream structure

Hea der	Cluster A+V	Cluster A+V	Cluster A+V	Cluster A+V

DASH live adaptive streaming structure

Hea der Aud	Cluster Audio 2s	Cluster Audio 2s	Cluster Audio 2s	Cluster Audio 2s	Cluster Audio 2s	Cluster Audio 2s]]	DASH Manifest .MPD
Hea der Vid	Cluster Video 2s	Cluster Video 2s	Cluster Video 2s	Cluster Video 2s	Cluster Video 2s	Cluster Video 2s		DASIT Walliest .WPD

{ Comparison with fragmented MP4 }

Live stream structure

EBML+ Segment +Track	Cluster A+V	Cluster A+V	Cluster A+V	Cluster A+V	Cluster A+V	Cluster A+V

460 bytes 25+data', 25+data', ...

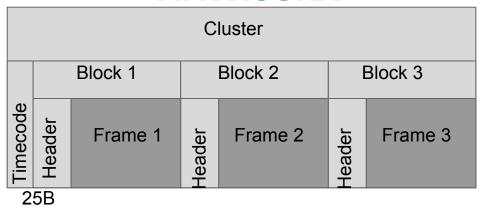
Fragmented MP4

Header	moof +					
ftyp+	mdat	mdat	mdat	mdat	mdat	mdat
moov	A+V	A+V	A+V	A+V	A+V	A+V

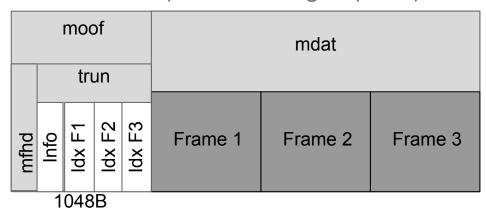
2100 bytes 850+data, 850+data, ...

{ Frames wrapping MKV vs fMP4 }

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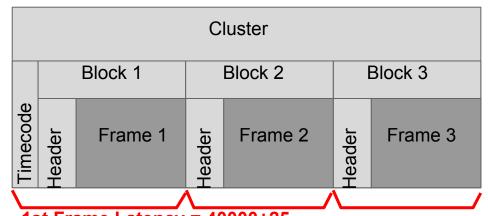


fMP4 (frame caching required)



{ Frame Latency MKV vs fMP4 }

MATROŠKA



1st Frame Latency = 40000+25 fMP4 (frame caching required)

moof		mdat	
trun			
Info Idx F1 Idx F2 Idx F3	Frame 1	Frame 2	Frame 3
1et Frame Leton			

1st Frame Latency = 40000+1048

{ Buffer Latency MKV vs fMP4 }

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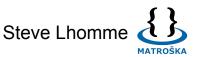
	Cluster								
		Block 1		Block 2	Block 3				
Timecode	Header	Frame 1	Header	Frame 2	Header	Frame 3			

Buffer before sending

= 20ms fMP4 (frame caching required)

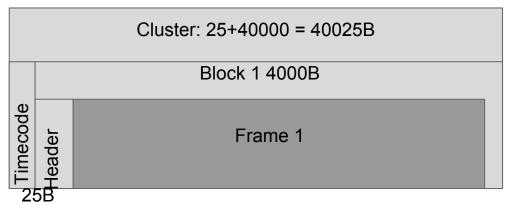
moof		mdat	
	Frame 1	Frame 2	Frame 3

Buffer before sending = 2s



{ Frame latency MKV vs TS }

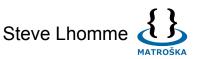
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Transport Stream

Frame1: (40000/184) * (184+4) = 40869B										
	188B		188B							
Header	Frame 1.1	Header	Frame 1.2	Header	Frame 1.3					

1st Frame Latency



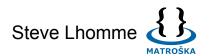
{ Latency Summary }

MKV/WebM vs fMP4/CMAF

- Slightly lower network latency
- MUCH lower buffering latency

MKV/WebM vs TS

- Lower network latency
- Similar buffer latency



{ **FIN** }

- Thank You
- Contribute (pretty please)
- Questions
- Stickers