OPTOFIDELITY

SMOOTH PLAYBACK OR BAD PERFORMANCE?

Comparison of video playback on three leading smartphones - the Huawei P9, iPhone 6S and Samsung Galaxy S7

Video is the new photography – today, video is one the most important ways to communicate, watching and sharing informative or amusing content. Since the use of videos is increasing rapidly, video playback performance has become one of the most important selection criteria for a smartphone. No matter how good he video content is, a poor video playback can ruin the whole message – or phone user experience.

We wanted to know how the best smartphones perform when watching local video or video directly from YouTube via a cellural or Wi-Fi network. We also wanted to show how to measure video playback performance with OptoFidelity Video Multimeter.

1. HOW DID WE CARRY OUT THE MEASUREMENT?

OptoFidelity has developed a novel measurement solution, Video Multimeter, which enables quick and accurate video playback measurements. When testing with Video Multimeter we use a test video that contains a controlled visual target. The test video has been uploaded to phones and to YouTube for the measurements. When the video is played from phone or YouTube, Video Multimeter collects the visual and audio data of the test video from the phone non-intrusively.

The mobile phones used in the testing were:

- Samsung Galaxy S7
- Apple iPhone 6S
- Huawei P9

The cellular network used in the testing were 4G from DNA Finland. The Public Wi-Fi network used in the testing was 802.11 a/b/g/n/ac, connected to 1 Gbps. During the test there was random, typical office traffic at all times.

We conducted three test cases: local playback, YouTube playback via cellular network and YouTube playback via Wi-Fi network. In each test case, we used four different kind of quality 50 second video file:

- 30fps H.264 1080p (FHD30)
- 60fps H.264 1080p (FHD30)
- 30fps H.264 2160p (UHD30)
- 60fps H.264 2160p (UH60)
- Each test case was measured twice and an average was taken from those results.

1.1 Composite MOS

OptoFidelity Video Multimeter outputs the results as a MOS (Mean Opinion Score) whose scale is from 1 to 5. A value of 1 means bad, unacceptable performance, and a value of 5 means excellent, flawless performance. The scaling of Video Multimeter MOS is based on well-known industry standards, suggestions and research studies.

SCORES QUALITY IMPAIRMENT

5	Excellent	Imperceptible
4	Good	Perceptible, but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Very annoying, unwatchable

1.2 Terminology

Following terms relate to typical features that affect the watching quality and experience:

FPS Jerkiness = Average FPS (Frames/Second) of the video playback

FPS Jitter = Standard deviation of video playback frame intervals

Dropped Frames = Average delay between dropped frames

Audio/Video synchronization = The delay between the user-experienced video and audio stream, called also 'lip sync'

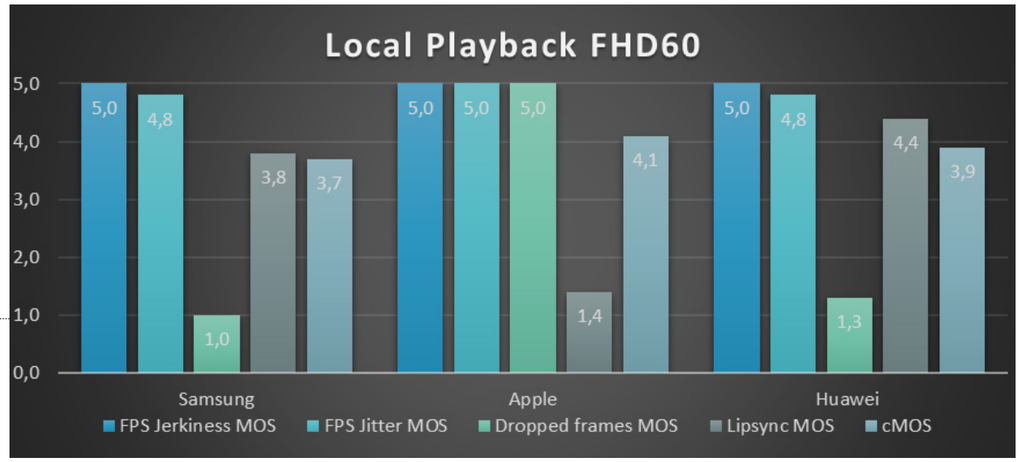
In the following sections we refer always to the MOS va- lues achieved by tested applications. Below are the results in a nutshell. The MOS values presented in the table are so-called 'composite' values, which represent the weighted average of the jerkiness, jitter, conversational latency and audio/video synchronization. We have visibility to individual MOS values, frame jitter for example. From the MOS values it is possible to drill down to detailed measurement data because frame and audio timestamps are recorded and stored in microsecond resolution.

2. RESULTS

In generally all the phones performed well with all type of videos. Even if the general MOS score was in good level, every phone had it's Achille's heel that decreased the general MOS score. Especially all the phones have problems when performing FHD60 and UHD60 videos no matter was it local or via YouTube. For Apple local playback of UHD60 was not even measured due to the fact that iTunes was not allowing to transfer material to the phone. In further results we point out only the most distinct results and differencies.

		Samsung Galaxy S7	Apple iPhone 6S	Huawei P9
Local	**FHD30**	4,7	4,2	4,2
	FHD60	3,7	4,1	3,9
	UHD30	4,3	4,1	4,3
	UHD60	1,3	- *	2,3
Youtube, Cellular				
	FHD30	4,6	4,0	4,6
	FHD60	3,4	4,1	3,2
	UHD30	4,6	4,0	4,6
	UHD60	3,5	3,5	3,2
Youtube, Wi-Fi				
	FHD30	4,6	4,0	4,6
	FHD60	3,3	4,9	3,1
	UHD30	4,6	4,0	4,6
	UHD60	3,4	4,7	3,1
Avg.		3,8	4,1	3,8

Picture 1: Overall results in cMOS.



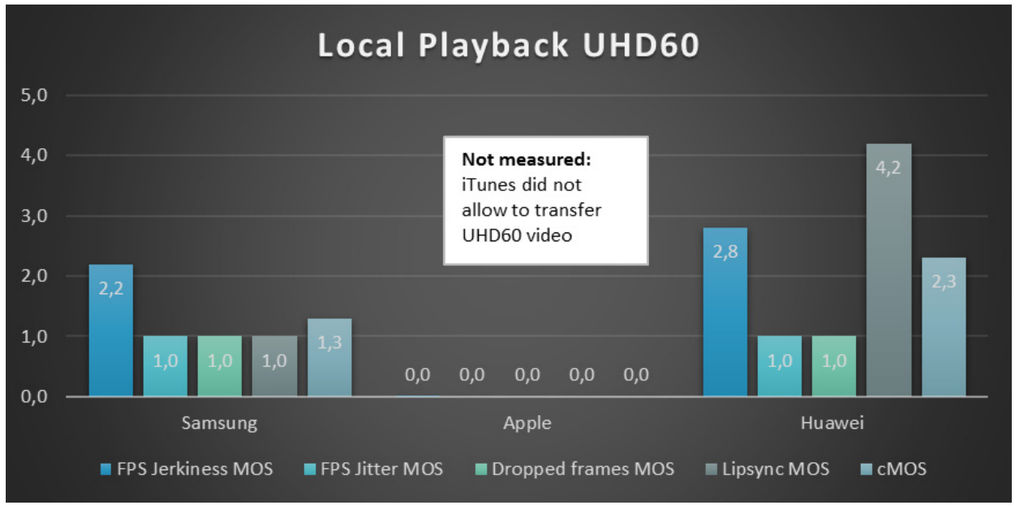
Picture 2: Local Playback FHD60. Again Apple had a Bad Lip Sync, Samsung and Huawei had problems with a lot of dropped frames.

2.1 Local playback

Quite naturally all the phones played FHD30 video most evenly and more variation between phones occured with higher quality videos.

Apple performs best from pure video performance point of view and the MOS score would have been solid 5 without noticably poor lip sync, audio video synchronization. iPhone had the same problem with all video qualities which decreased average composite MOS to 4.1 ("Good"). Apple was able to perform FHD30, FHD60 and UHD30 playback at "Good" level but as mentioned UHD60 could not be measured.

When comparing cMOS value of all video qualities Huawei and Samsung are quite even (average cMOS values 3.7 and 3.5 respectively) so both performs "Fair" where Huawei is slightly closer to "Good". Both perform "Good" with 30 fps videos, but clearly worse playback with 60 fps videos decreses the general cMOS value. Samsung performs slightly better with FHD30 file (+0.5 higher Composite MOS value) where as Huawei is better with UHD60 (+1.0 higher Composite MOS value). Samsung's UHD60 playback was Bad (Composite MOS 1.3). Surprisingly both Samsung and Huawei had a lot of dropped frames with FHD60 video. When the MOS value is this low, dropped frames makes video noticeably poor and unwatchable for user.



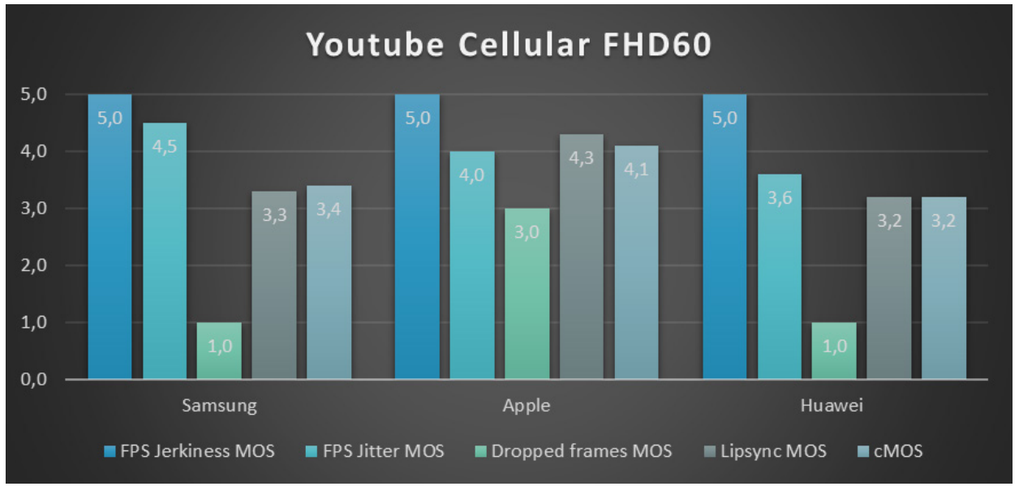
Picture 3: Local Playback UHD30. Both measured phones had big problems, yet Huawei had a surprisingly good lip sync with this video quality.

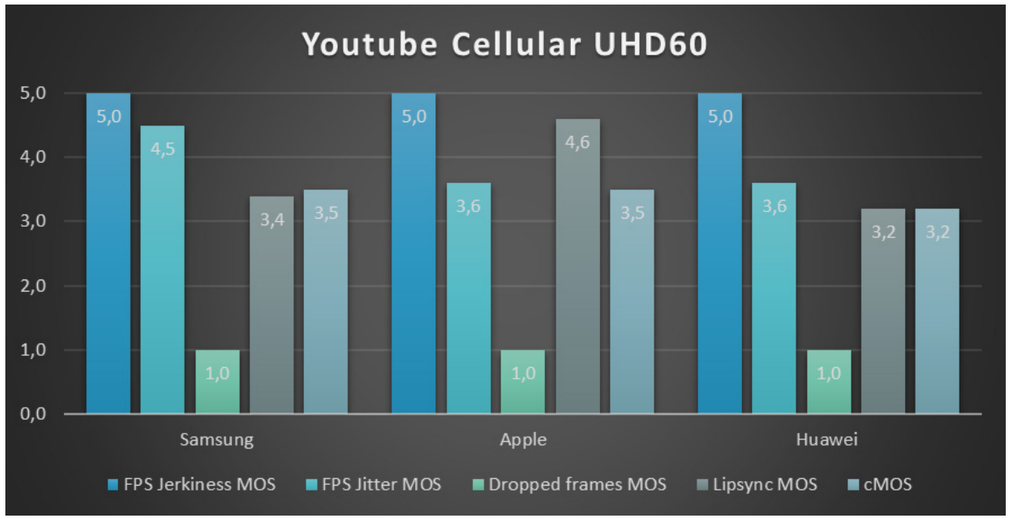
2.2 YouTube playback via cellular network

When measuren via cellular network all phones played both 30 fps videos better. All three performed "Good" or almost "Good" (average cMOS for Samsung 4.0, Apple and Huawei both 3.9). Apple performs best from pure video performance point of view, e.g. clear MOS 5 with FHD30 video with jerkiness, jitter and Dropped frames but again noticeably poor audio video synchronization with 30 fps videos decrease composite MOS to 3.9 (~"Good"). It seems that Apple's lip sync is getting better with 60 fps videos compared to 30 fps playback. Also Samsung and Huawei performed very "Good" with 30 fps videos.

Again Samsung and Huawei started to drop frames when streaming of FHD60 files. The result was "Bad" (MOS: 1.0) while Apple drops somewhat less (MOS: 3.0). All three devices starts to drop frames badly while streaming UHD60 files (MOS: 1.0 for each).

Picture 4: Youtube cellural playback FHD60. All phones started to have problems. The common problem was dropped frames where Samsung and Huawei had noticeably "Bad" MOS value.





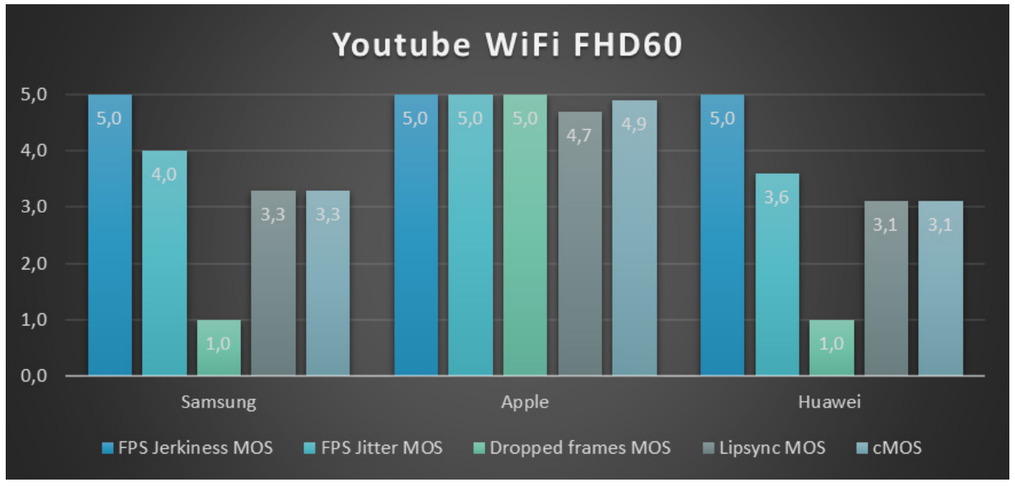
Picture 5: Youtube cellural playback UHD60. All phones had bad problems with dropped frames, general MOS category for all phones vere only "Fair".

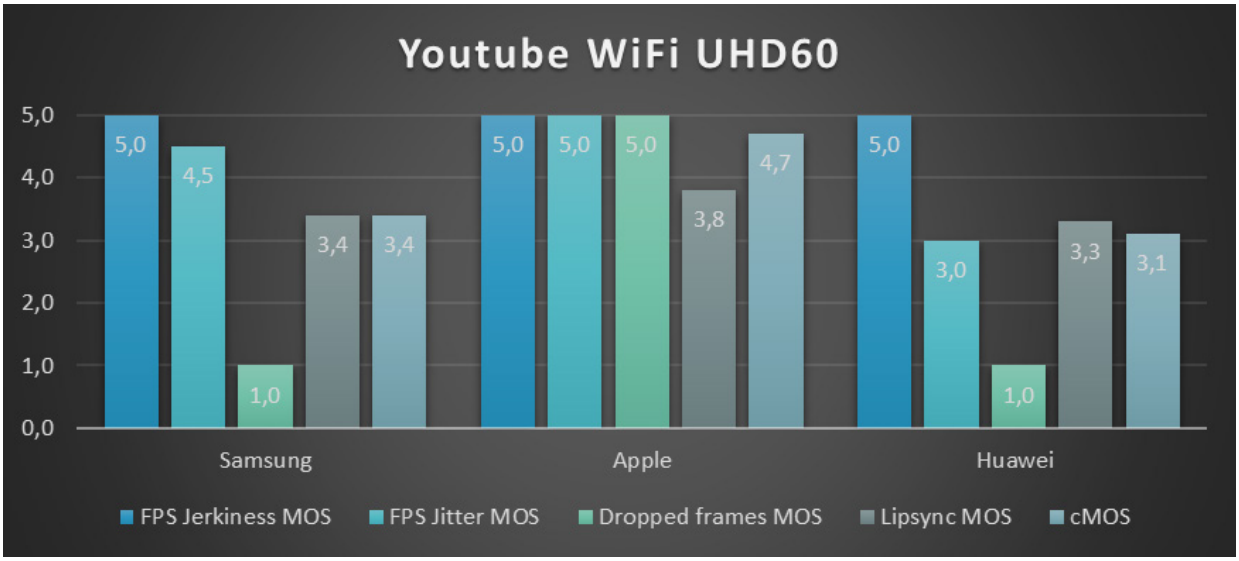
2.3 YouTube playback via Wi-Fi network

Same trend in results continued when comparing playback perforamnce performance via Wi-Fi network. Phones had good and quite equal performances with 30 fps videos and more variation appearrf with 60 fps video quality. Even problems seemed to be equal to other test cases, and most of them are related to lip sync and dropped frames.

Apple and Samsung performed at "Good" level (average CMOS for Apple 4.4 and Samsung 4.0). Huawei was very close, almost at "Good" level (average CMOS 3.8). Appless biggest problem was again a poor audio video synchronization – between "Poor" and "Fair" (average Lip sync MOS 2.6). It seemed again that Apple's lip sync is getting better with 60 fps videos compared to 30 fps playback. Samsung and Huawei had biggest problems with 60 fps files: a lot of dropped frames.

Picture 6: YouTube Wi-Fi playback FHD60. Samsung and Huawei had bad probles with dropped frames, also with lip sync which dropped MOS category "Fair". With this video quality Apple performed well also with the lip sync.





Picture 7 YouTube Wi-Fi playback UHD60. Apple performed steatily and lip sync was nearly "Good". Samsung and Huawei had decreased MOS values vor dropped varmes, lip sync and therefore for general MOS.

3. CONCLUSIONS

As mentioned all the phones performed mainly "Good" compared by overall cMOS values. Jerkiness and Jitter were "Good", even nearly "Excellent" level so cutting in and out is not a problem for these phones. For all phones most common problems in video playback performance were related to dropped frames and lip sync.

Apple was the most stable performer even it had a general problem with lip sync. There was certain pattern in the Apples lip sync problems that can also be detected with OptoFidelity Video Multimeter. Anyhow the phone performed better with 60 fps videos. The best result of all test cases had Apple via Wi-fi YouTube playback with FH60 video (average cMOS 4,9).

Also in general Samsung and Huawei performed mostly "Good", but they both had problems with 60 fps videos and dropped frames. It is interesting to speculate the reason for a such uniform disruption – could it possibly be just a lack of capacity with the Android phones?

Even though the results were generally at level "Good", there are still annoying factors for the user.

Apple's thoroughly "Bad" lip sync is a visibly effect for users. It's even more annoying when the synchronization error occurs by the voice being fast. When this outcome occurs nearly every video quality, it may start to violate the user experiencea as a whole. In the same way Samsung and Huawei phones had a serious amount of dropped frames that are visible for the user even at the same time the other playback features were "Good".

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