

# Video-Decoder Power Consumption on Android Devices: Power-Estimation Method, Dataset Creation, and Analysis Results

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This work presents a generic software-based method for estimating the power consumption of video decoders on various Android devices. Its main idea is to retrieve the devices battery level and to access video-decoders using the Android BatteryManager and Media APIs. The formula for computing the relative battery consumption (%) when decoding the entire bitstream with  $n$  frames in autonomous mode and the formula for computing the average decoding speed (frames/second) are as follows:  $\Delta_{seq} = \frac{B_0 - B_1}{(N_1 - N_0)n + n_1 - n_0} \cdot n$ ,  $v = \frac{(N_1 - N_0)n + n_1 - n_0}{T_1 - T_0}$ , where the battery levels are  $B_0$  and  $B_1$  at times  $T_0$  and  $T_1$  (in seconds), respectively, corresponding to decoding iterations  $N_0$  and  $N_1$  and frame indices  $n_0$  and  $n_1$ .

In this work we compute two valuable power metrics. The first is relative battery consumption per hour of autonomous playback  $\Delta_{play}$  (in %/hour):

$\Delta_{play} = \left( \Delta_{seq} \cdot 3600 + \Delta_{screen} \max\left(0, \frac{n}{fps} - \frac{n}{v}\right) \right) \frac{fps}{n}$ , where  $fps$  is the number of frames per second required for playback and  $\Delta_{screen}$  is the energy that the display consumes.

The second is video-decoding energy per hour,  $\Delta_{decode}$  (in mA), which helps Android-device manufacturers estimate the power efficiency of video decoders:

$\Delta_{decode} = V \left( \Delta_{seq} \frac{v}{n} \cdot 3600 - \Delta_{screen} \right)$ , where  $V$  is a battery capacity (mAh).

Using the method, we developed an automatic system that consists of Android application – *VEQE save battery by codec!* – posted in Google Play, to measure the power consumption of video decoders and a server to collect the metrics. We prepared a server-side script to retain good-quality data submissions and collected data by posting an exercise in Yandex.Toloka that paid participants to launch our application. The system allowed us to create power-consumption and decoding-speed dataset for video decoders operating on 236 devices, representing 147 models.

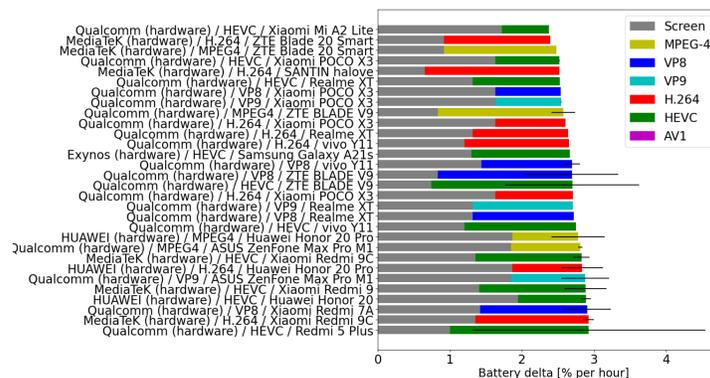


Figure 1:  $\Delta_{play}$  for the top 30 video decoders at HD resolution.