



## Methodology: Video Experience Awards

Millions of users around the world trust Speedtest® to measure the performance of their fixed and mobile networks every day. Our in-app video test provides consumers with a tool to measure streaming video performance in a typical consumer scenario such as a video playing on a web page, or within a social media application and to determine the maximum characteristics that their device and network connection are capable of, when pushed to perform maximally.

This document is intended to provide licensees of Ookla Marketing Rights and interested parties with transparency into the methodologies used to calculate and validate Video Experience Awards. This document may be shared with regulatory bodies, media or others, as needed.

## Methodology Overview

Video Scores are based on the adaptive bitrate stage of Ookla's consumer-initiated video experience test. Video Scores are composed of five components, each measuring a different aspect of consumer video experience. These components are evaluated and then scored on a scale of 0-100 for each eligible provider using scoring functions. Finally, scored components are combined in a weighted average to produce the final Video Score.

### Process

Ookla's data analysis process consists of four main steps: collect, filter, normalize and aggregate. The outputs of this process are then leveraged to determine Video Experience Award winners.

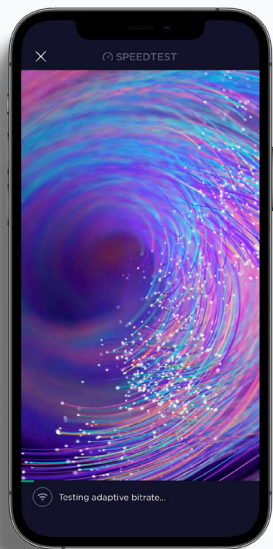
### Collection

Mobile app users can access the video test feature through the features displayed in the bottom navigation bar. When the user engages the "play" button in the center of the screen, the video test will begin playing a proprietary, visually-rich animation.

The video test consists of two stages:

- An **Adaptive Bitrate (ABR)** stage, during which the video player controls the displayed resolution, while the application measures the time spent in various resolutions
- A series of **Fixed Bitrate** stages during which the video player plays content at a fixed resolution, progressively increasing the resolution until a timeout on the first frame occurs, re-buffering exceeds 20% on an individual stage, or the highest resolution is reached

The purpose of the ABR stage is to measure the performance of streaming video in a typical consumer scenario, such as a video playing on a web page or within a social media application. The purpose of the fixed stages is to determine the maximum characteristics that device and network connection are capable of when pushed to perform maximally.



## Data Quality Filtering and Sample Construction

To ensure that the data is accurate and reflective of actual consumer experience, each video test result is subject to Ookla’s proprietary data quality filters. Additionally, video test results are filtered or omitted from sample construction if their results are not applicable to other metrics in the test sequence (e.g. when computing rebuffering ratio, tests that failed to start are omitted).

To ensure that each user has an equal voice, we apply a user aggregation methodology to video test results. This means that a user can submit any number of video test results during any arbitrary time period, but they will only contribute one “vote” to any period of observation.

## Video Score Construction

Video Scores are based on the adaptive bitrate stage of Ookla’s consumer-initiated video experience test. Video Scores are composed of five components, each measuring a different aspect of consumer video experience.

Video Score Component	Description
Adaptive Start Failures (%)	The percentage of video samples where a start timeout or other failure occurs, causing the video not to start playback during the adaptive bitrate stage of the video test.
Median Adaptive Start Time (s)	For each sample, the mean time spent waiting for the video to start playing during the adaptive bitrate stage of the test is computed as the “adaptive start time”. The median of these sample values is computed and used as a Video Score component. Measured in seconds.
Median Adaptive Average Bitrate (Mbps)	For each sample, the average media bitrate observed during the adaptive bitrate stage of the video test is computed. The median of these sample values is computed and used as a Video Score component. Expressed in megabits per second (Mbps).
Adaptive Stall Events (%)	During the adaptive bitrate stage of the video test, if a user experiences a stall (pause in playback for rebuffering) it is considered a stall event. “Adaptive Stall Events” is the percentage of video samples where at least one stall event has occurred.
Median Adaptive Stall Severity (%)	Adaptive Stall Severity is the ratio of time spent rebuffering to time spent playing in the adaptive bitrate stage of the video test, given that a stall event has occurred (see Adaptive Stall Events). The median of these sample values is computed and used as a Video Score component.

Video Score components are evaluated and then scored on a scale of 0-100 for each eligible provider using the scoring functions specified in the table below. Each component is assigned a weight based on its importance toward creating a great overall video experience. For example, the Adaptive Start Failures (%) component is weighted heavily, because inability to start video playback is one of the more frustrating video experiences that consumers report. Component scores are then combined in a weighted sum to create the final Video Score.

*Table 1: Scoring functions and weights associated with each Video Score component.*

Video Score Component (x)	Scoring Function	Lambda ( $\lambda$ )	Weight
Adaptive Start Failures (proportion)	$f(x) = 100 * e^{-\lambda x}$	5	40%
Median Adaptive Start Time (ms)	$f(x) = 100 * e^{-\lambda x}$	2.5e-04	30%
Median Adaptive Average Bitrate (bps)	$f(x) = 100 * (1 - e^{-\lambda x})$	5e-07	10%
Adaptive Stall Events (proportion)	$f(x) = 100 * e^{-\lambda x}$	4	15%
Median Adaptive Stall Severity (ratio)	$f(x) = 100 * e^{-\lambda x}$	1	5%

Figure 1a

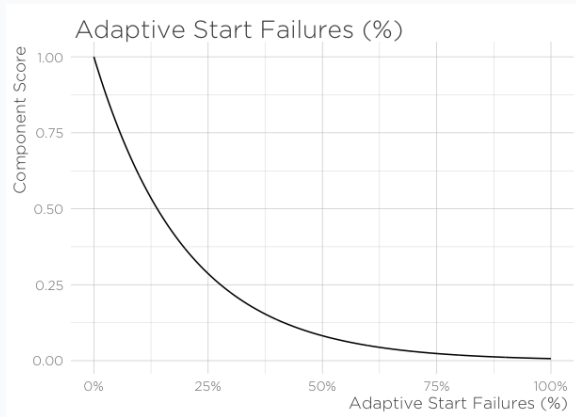


Figure 1b

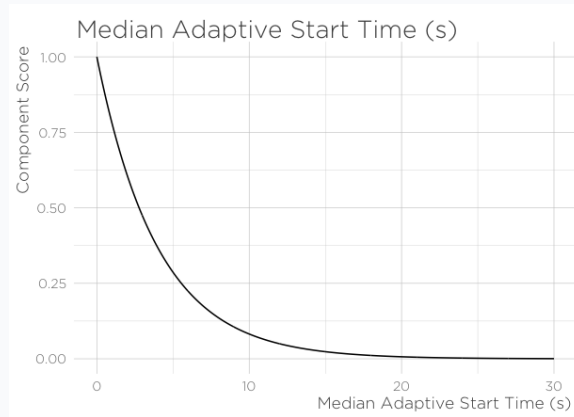


Figure 1c

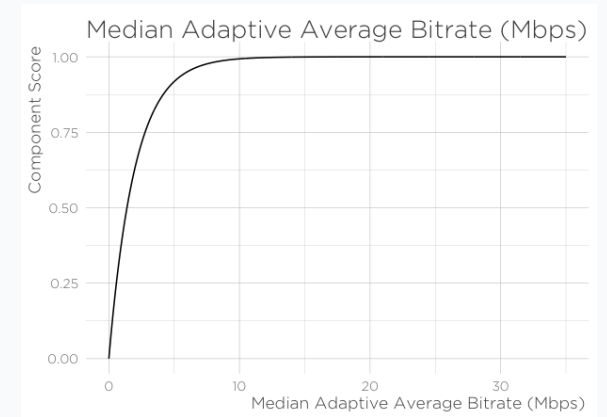


Figure 1d

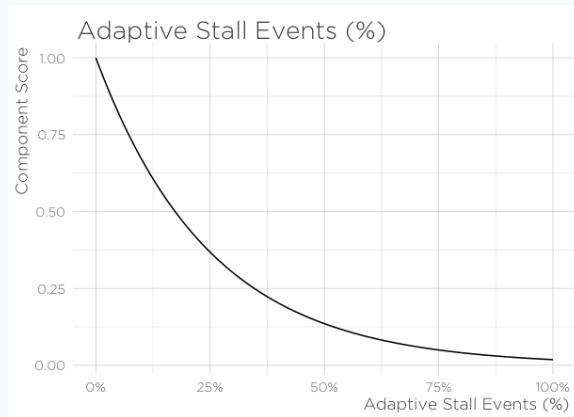
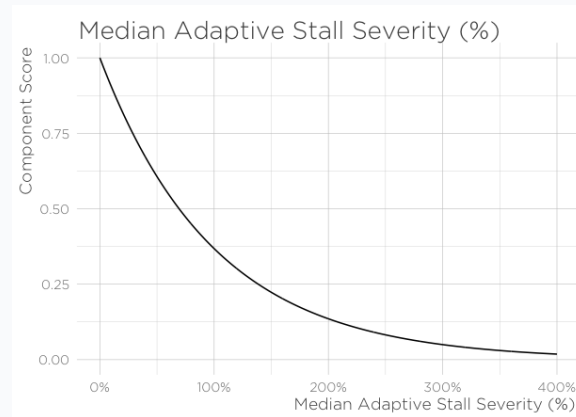


Figure 1e



### **Statistical Evaluation**

Winners are those providers found to have the highest Video Score among competitors in the market, accounting for statistical uncertainty. Specifically, Multiple Comparisons with Best (MCB) is used to evaluate winners.

### **Time Criteria**

All Speedtest Awards are based on six months of historical data within the same calendar year, called the award period. By using a six-month time period, it reduces the likelihood that short-term fluctuations in ratings will significantly influence the analysis.

### **Market Share and Geography Criteria**

All Speedtest Awards are tied to a specific location, for example, a country. To be considered for the Speedtest Awards, a fixed or mobile network must have a minimum of 3% of the total number of samples within that specific geographic area over the specified time range. If a provider has less than 3% of the total samples in a region, it is an indication that they are not widely available in that location. The intention of the Speedtest Awards is to identify the Best Video Experience offered by fixed and mobile networks that are generally available to consumers in a specific geographic area. This threshold allows us to include relevant start-ups or other local providers, while removing those that are otherwise not generally available within the area.

## Understanding Video Score

Ookla's Video Award reports provide full transparency into the construction of Video Scores, including how each individual component contributes to the final score. Table 2 provides a hypothetical example to illustrate how Video Scores are constructed. Video Scores are composed of five components, each measuring a different aspect of consumer video experience.

In this example, the provider achieved an Adaptive Start Failure rate of 8.18%. Using the scoring function for Adaptive Start Failures specified in Table 1 and plotted in Figure 1a, the provider's Adaptive Start Failure rate earned a component score of 66.42. Since Adaptive Start Failures represent one of the most impactful aspects of the video experience, this component carries a relatively high weight of 40% in the final Video Score. To determine how many points the Adaptive Start Failures component contributed to that provider's final Video Score, the component score (66.42) is multiplied by the component weight (40%), resulting in 26.57 points. The sum of all component score points is the final Video Score (74.03 in this example).

*Table 2: Illustrative example of a scorecard used to compute a hypothetical provider's Video Score. Note that Video Score component values should be converted to the units specified in Table 1 before scoring.*

Video Score Component	Component Value	Component Score	Weight in Video Score	Video Score Points
Adaptive Start Failures (%)	8.18	66.42	40%	26.57
Median Adaptive Start Time (s)	1.16	74.77	30%	22.43
Median Adaptive Average Bitrate (Mbps)	4.47	89.31	10%	8.93
Adaptive Stall Events (%)	5.36	80.71	15%	12.11
Median Adaptive Stall Severity (%)	22.5	79.85	5%	3.99

**Video Score**  
**74.03**