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| **ITU-T** | **P.917** | |
| TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU | | (01/2019) |
|  | SERIES P: TELEPHONE TRANSMISSION QUALITY, TELEPHONE INSTALLATIONS, LOCAL LINE NETWORKS  Audiovisual quality in multimedia services | | | |
|  | **Subjective test methodology for assessing impact of initial loading delay on Quality of Experience** | | | |
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Recommendation ITU-T P.917 (ex P.QUITS)

Subjective test methodology for assessing impact of initial loading delay on Quality of Experience

Summary

This Recommendation defines a procedure for conducting behavioral studies targeted at investigating video streaming performance and its relation to users’ Quality of Experience. The studies are to be conducted in controlled environments. Subjects are exposed to different initial loading delay conditions and other quality degradations typical for video streaming, and may be asked to rate audiovisual quality or their experience. Additionally, their behavior as a response to long loading times (i.e. aborting the video playback during its loading phase) may be investigated.

Keywords

Initial loading delay, Quality of Experience, Video streaming

Introduction

Initial loading delay during video streaming is known to impact the QoE of end-users. However, the specific relationship between initial loading delay and the users’ likelihood to abort a playback – or the perceived overall quality of the initial loading delay and/or entire media session – varies for different services. Furthermore, it depends on the expectations of the users. It is important for Internet Service Providers to be able to assess the impact of initial loading delay on user QoE, as numbers quantifying these relationships are not readily available.

In this recommendation, a procedure for conducting studies with human test subjects is described. These studies are called behavioral, since interaction with a (simulated) video streaming service is the main focus. Results from a study conducted following to this recommendation may be used for several purposes, including but not limited to developing prediction models that estimate:

a) the likelihood of users abandoning a video playback during its initial loading phase and/or

b) the perceived overall quality of a video playback impacted by initial loading, stalling, and audiovisual quality changes, and/or

(c) the perceived quality of the initial loading experience.

The test procedures specified in this recommendation aim to bridge the gap between traditional video quality assessment methods such as specified in ITU-T Rec. P.910 and large-scale data collections that Over-the-top video providers may conduct.

First, background and related work on tests aimed at assessing the impact of initial loading delay are described. A general overview of factors that influence user behavior and subsequent ratings is given. Then, the document describes a test procedure, which is to be conducted in a controlled environment.

# 1 Scope

This recommendation describes a test methodology for use in controlled environments with human subjects. The scope of this recommendation is currently limited to the following factors:

* Test environment: controlled environment (see [ITU-T P.913], clause 8.1)
* Video length: Short videos (< 5 minutes)
* Simulated platform: Video-on-demand
* Test devices: PCs or mobile phones

The technical scope is limited to progressive download streaming and adaptive streaming type services (using reliable transport), which includes:

* Over-the-top (OTT) services, as well as operator managed video services (over TCP)
* Video over both mobile and fixed connections
* The protocols HTTP/TCP/IP, RTMP/TCP/IP, HLS/HTTP/TCP/IP, and DASH/HTTP/TCP/IP. Note that the recommendation is agnostic to the specific network delivery method (HTTP or DASH or other), with one exception that it assumes reliable delivery (TCP/IP) that results in apparent loading times (indicated with a “buffering” symbol to the user).
* Video services typically using container formats such as Flash (FLV), MP4, WebM, 3GP, and MPEG2-TS. Note that the test method is agnostic to the type of container format.

The methods described in this recommendation may be used in other technical contexts where users browse content and have to wait for media playback (e.g. music streaming), but it has not been validated in such contexts.

# 2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T P.910] Recommendation ITU-T P.910 (04/2008), *Subjective video quality assessment methods for multimedia applications*

[ITU-T P.913] Recommendation ITU-T P.913 (03/2016), *Methods for the subjective assessment of video quality, audio quality and audiovisual quality of Internet video and distribution quality television in any environment*

[ITU-T P.1203] Recommendation ITU-T P.1203 (10/2017), *Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport – Video quality estimation module*

[ITU-T P.1203.1] Recommendation ITU-T P.1203.1 (10/2017), *Parametric bitstream-based quality assessment of progressive download and adaptive audiovisual streaming services over reliable transport*

[ITU-T P.10/G.100] Recommendation ITU-T P.10/G.100 (11/2017), *Vocabulary for performance, quality of service and quality of experience*

# 3 Definitions

**Quality of initial loading experience:** The degree to which a user’s expectations of the initial loading delay are fulfilled.

## 3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

**3.1.1 Initial Loading Delay** [ITU-T P.1203]

**3.1.2 Stalling** [ITU-T P.1203]

**3.1.3 Integral Quality** [ITU-T P.1203]

**3.1.4 Quality of Experience** [ITU-T P.10/G.100]

## 3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

**3.2.1 Overall quality**: same as *Integral Quality*

# 4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACR Absolute Category Rating

FHD Full HD (1920x1080)

HD High Definition (television)

HRC Hypothetical Reference Circuit

MOS Mean Opinion Score

PVS Processed Video Sequence

QHD Quad HD (2560x1440)

SRC Source

# 5 Conventions

None.

# 6 Background

In the literature, it has been shown that user experience with regard to initial loading delay is impacted by several factors, including human, system, and contextual factors (for factors influencing Quality of Experience, see [Reiter 2014]). These have been analyzed in various studies, such as [Dobrian 2013] and [Krishnan 2013] for the case of large-scale data from real streaming services. The studies have shown that previous experiences of users (leading to expectations about their Internet performance) heavily influence their engagement patterns. The problem with these studies is that the underlying data is not available and hence does not allow building a model. Also, Mean Opinion Scores are not captured for these types of data.

In a laboratory context, there have been attempts at presenting users with patterns of video delivery degradations and studying their behavioral responses or quality ratings, such as [Mok 2011] and [Robitza 2016]. Mok et al. captured quality rating responses plus user behavior (such as seeking or pausing the video) from the participants, but the paper is not detailed enough regarding the test paradigm description in order to allow reproducing the experiment.

Robitza et al. found that 1/3rd of test participants – when they do not know that initial loading or stalling will happen – will react differently than in normal life, thus not showing the expected behavior. The users had not been informed that problems will occur when attempting to load a video. This test series showed that it is possible to elicit realistic responses from video loading degradations, such as getting people to reload the browser window or to select another video, but a systematic test of different loading patterns will be impossible with this paradigm, without testing a large number of people.

In order to develop a model that predicts the subject’s initial loading experience for a video session, one may use a Mean Opinion Scores (MOS) methodology. This is in line with other models that use the MOS as a simplification for quantifying the user’s Quality of Experience, without giving the user any other means to indicate a bad experience. However, in practice, the experience of the user may translate to a certain corrective action (e.g. cancelling the video playback). Hence, the option of quitting the video loading process will be given to the test subjects.

# 7 Factors Influencing User Behavior and Ratings

When gathering MOS or assessing user abandonment, it is expected that users will be influenced by several factors during the test. These factors may bias the ratings or user behavior, making ratings either more or less critical when compared to a rating that would be taken in real life, or leading to users not behaving as they would normally do, for example at home.

Table 1 Factors influencing ratings

| **Factor** | **Comment / Explanation** | **Possible influence on ratings** | **Possible alleviation** |
| --- | --- | --- | --- |
| Intrinsic motivation to watch video | Do users want to watch the upcoming video because they are interested in it or the continuation of the test? | Might yield less critical ratings if users do not want to watch video at all, do not care about content | Show more interesting content; do not repeat content |
| Extrinsic motivation to watch video | Are users being motivated to watch video? | Might yield less critical ratings if users have no reason to watch videos | Give users a realistic task that relates to video content; do not repeat content |
| Test hypothesis communicated to users | What do subjects think this test is about? (What do the researchers want to know?) Subjects may want to “please” experimenter | Might skew ratings depending on whether subjects want to fulfill this hypothesis | Give written instructions to subjects; be clear about hypothesis |
| Realism of the test environment | How realistic / ecologically valid is the simulated test environment? (e.g. presenting within a real browser vs. just video playback software) | Might skew ratings | Increase realism of test environment platform (software); be clear about simulated physical context (e.g. home) |
| Assumption of usage context | What are subjects told they should *imagine* they are doing? | Might skew ratings | Be clear about usage context (e.g. Video on Demand vs. Live vs. Duration of content etc.) |

# 7 Test Method Description

The following section describes a method to gather user ratings and observe user behavior (i.e., quitting during video loading) in a laboratory context. Where indicated, modifications to the method are allowed. If deviations from the method are made, they must be properly documented.

## 7.l Test Platform

The test must be conducted on a platform that simulates a real video platform with which users may already be familiar. It should therefore use similar navigation patterns and have similar performance. This is expected to yield more realistic ratings and behavior.

The test platform may be a PC-based or mobile phone-based platform. It must be noted that different browsing and interaction patterns are commonly used for such platforms.

The user interface of both platforms should have two key components: a navigation bar and a video grid. Through the navigation bar, subjects can browse different video categories, and the related videos will be shown on the video grid as a list of thumbnails.

When subjects select a specific video by clicking its thumbnail, the video will start to play after an initial loading period. The subject may be allowed to abort the video playback at any time during the initial loading period, either through a dedicated button in the interface (e.g., an *X* button), or a hardware button on the device (e.g., a “back” button).

## 7.2 Source Content

### 7.2.1 Genres

The audiovisual material (SRCs) must be representative of typical video clips on major VoD websites. The SRCs may for example belong to any of the following genres:

1. Movies, movie trailers
2. TV Shows
3. Sports
4. Music videos
5. Animation
6. News
7. Documentaries
8. Comedy

The test platform may expose these genres as navigation categories in order to enable subjects to browse through the content based on their interests.

### 7.2.2 Characteristics and Length

The SRCs must provide well-synchronized audio and video content, i.e. lip-synchronicity must be guaranteed for non-dubbed video material and must be good enough for dubbed video material. SRCs should also provide a natural combination of the presented audio and video signal content. Dubbed video material is allowed in countries where users are typically watching dubbed video.

It is recommended to use interesting and/or engaging SRCs, such that subjects will be presented videos that they will be motivated to watch. This is expected to increase the validity of the captured behavior and ratings.

For the scope of the presented test methodology, the duration of each video sample should be less than 3 minutes.

## 7.3 Test Conditions

During the test procedure, subjects may be shown different audiovisual quality and different combinations of initial loading delays and stalling with varying length and frequency of the latter. A particular instantiation of initial loading delay, stalling, and audiovisual quality profile is called a Hypothetical Reference Circuit (HRC).

### 7.3.1 Types of Degradations

The audiovisual quality may be intentionally degraded by the use of different video codecs, and/or by reducing the video resolution, bitrate, and/or framerate, as typically done for HTTP Adaptive Streaming services.

Within an HRC, audiovisual quality may change (quality switching) to simulate network bandwidth fluctuations. Typical quality switching patterns may be included in the HRC design, such as ramp-ups (switching from low to high quality after initial loading).

Initial loading delays may vary between short (0.1 seconds) and long (60 seconds).

Stalling events may vary between short (0.1 seconds) and long (60 seconds). There is no limit to the number of stalling events, but it should be kept reasonable.

### 7.3.2 Resolutions, Codecs and Codec Settings

The encoding schemes of video streaming providers differ depending on the type of streamed video and the video codecs being used. The particular choice of video codec and encoding settings will therefore depend on the application under study.

Examples of common video coding resolutions and video bitrate ranges can be found in [ITU-T Rec. P.1203.1].

The lowest and highest video resolutions used in a test may differ between mobile and PC platforms, respectively. For example, a mobile phone may not be able to display 2160p video.

### 7.3.3 Reference Conditions

The following Table lists possible reference initial loading and video coding conditions (HRCs) to be shown in the test. These should be shown to every subject in order to produce anchors for high and low quality ratings, respectively.

Table 2 – Test Conditions

|  |  |  |
| --- | --- | --- |
| **Anchor** | **Initial Loading Time** | **Quality Switch Pattern** |
| High quality reference | Very short | Constant high resolution |
| Medium quality reference | Short, but noticeable | Constant medium resolution |
| Low quality reference | Long | Constant low resolution |

## 7.4 Assignment of SRCs to HRCs

To produce Processed Video Sequences (PVSes), a SRC must be paired with an HRC. For a complete test, it is recommended that all HRCs are shown at least once to every subject.

To prevent subject fatigue or boredom, a SRC should not be shown twice during a test. Once a SRC has been chosen, it shall be removed from the list of available SRCs and shall not be played again during the same visit time of the subject. An already played SRC may be greyed out in the user interface to prevent subjects from selecting it again.

There are two general approaches for associating SRCs with HRCs:

1. When a SRC is selected by the subject, an HRC is selected randomly from the entire list of HRCs. The HRC will not be shown again (sampling without replacement).
2. The pairing of SRCs and HRCs is determined before the test, and it is the same for all subjects. When an SRC is selected by the subject, the matching HRC is selected based on the pairing.

Each HRC may be shown more than once during a test, in order to increase the number of ratings and thereby also increase the reliability in determining the impact of the HRC on the measured variables. In this case, the HRC can be sampled more than once in option 1 above.

## 7.5 Overall Test Procedure

The overall test consists of several steps (see Figure 2).

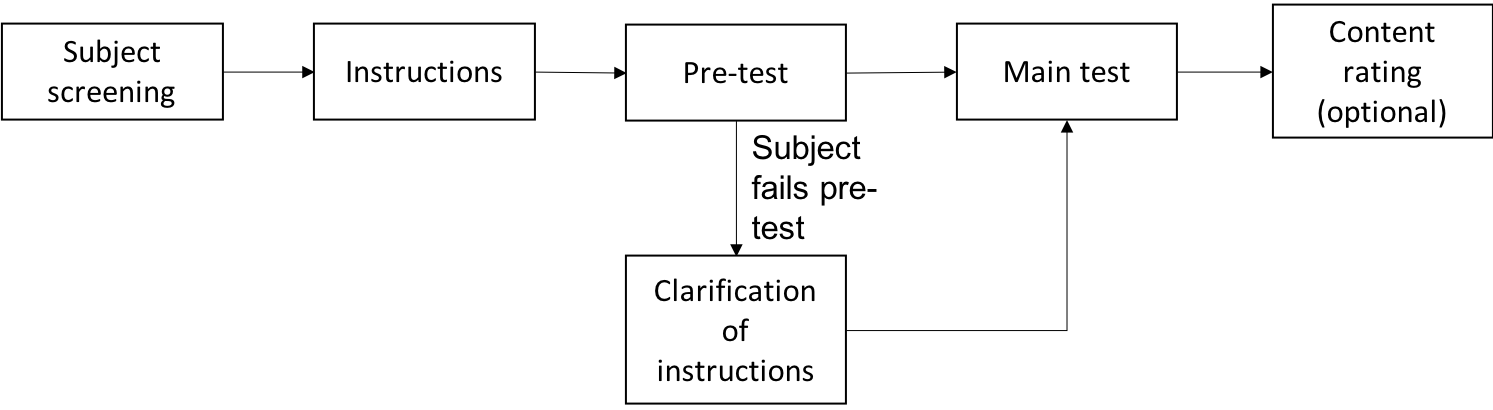


Figure 1 – Test Procedure

### 7.5.1 Subject Screening

Subjects may be screened before the test; see clause 7.7.2.

### 7.5.2 Instructions

Subjects must be given instructions (see Appendix I) in written form, which explain the overall test procedure including the training, pre-test, and main test procedure.

### 7.5.3 Length of Test and Sessions

For a single test, the time of actively viewing videos or hearing audio and voting should be limited to a maximum of 60 minutes. The total visit time, including instructions, training, main test, and content rating procedure, should be limited to 1 hour 45 minutes.

Each test may be split into 2–3 sessions between which subjects have a short break (5–10 minutes). A single session should last no longer than 30 minutes.

### 7.5.4 Training Procedure

The first session of each visit includes a training phase. This phase consists of showing the subject(s) how to use the test platform, which includes getting familiar with the user interface of the video platform, browsing and playing video contents, showing the rating screen, the types of video material, initial loading delay, stalling, and the quality range of the video sequences.

The training procedure consists of the same steps as the main test procedure (see below).

As an example, in the training phase, a total of 4 videos may be viewed by the subjects. Each video may be shown with one of the following conditions:

1. Short initial loading time (< 1 s), good video quality (e.g., 720p or higher)
2. Medium initial loading time (< 10 s), medium video quality
3. Medium initial loading time (< 10 s), bad video quality
4. Long initial loading time (1 min), bad video quality

Unlike the main test procedure, during training, the video playback may end already after 30 s, after which subjects are shown the rating screen.

When a video with extreme lengths of initial loading delay is shown, if a subject does not abort this playback, it can be assumed that the subject has not understood the instructions or goals of the test procedure. In this case, further clarification of the instructions should be given to the subject after the training phase is completed.

### 7.5.5 Main Test Procedure

The main test procedure consists of several steps. The user interface must alternate between showing the video overview, the video initial loading period, the video playing, and a rating screen.

#### 7.5.5.1 Video Overview / Browsing

The subject browses the video platform and finds a video he/she would like to view, optionally by filtering different video categories. Once the subject finds the video, he/she can click on the video thumbnail for starting the playback.

#### 7.5.5.2 Initial Loading Period

The videostarts to load according to the initial loading delay of the HRC chosen in the test design. During the loading period, if the subject feels the loading delay is too long, he/she may abort. going back to the overview.

#### 7.5.5.3 Video Playing

The video starts to play with the audiovisual quality according to the HRC chosen in the test design, optionally interrupted by stalling events.

#### 7.5.5.4 Rating Schemes

There are two rating elements, from which either one or both may be shown (see below for details on allowed rating questions in each element):

* **Rating Element 1:** Directly after the video has started playing, the subject is asked to provide ratings. This captures the subject’s opinion directly after a possibly good or bad loading experience.
* **Rating Element 2:** After the video playback ends, the subject is asked to provide ratings. This captures the subject’s opinion after the entire video watching experience.

There are three rating schemes, depending on the choice of rating elements:

* **Rating Scheme 1:** Rating Element 1 is shown
* **Rating Scheme 2:** Rating Element 2 is shown
* **Rating Scheme 3:** Rating Element 1 and 2 are shown

The choice of rating scheme(s) and included rating questions depends on the overall aim of the test, and the particular kind of model that may be developed based on the subjective test results.

On the one hand, Rating Element 1 aims at capturing the subject’s experience immediately after starting the playback; it may therefore yield more critical ratings than Rating Element 2. The use of more critical ratings may be of importance to operators who want to optimize for a quick loading experience. Rating Element 2 on the other hand resembles the remembered quality of an entire session and is therefore comparable to the subjective experiment design as used in, for example, [ITU-T Rec. P.1203]. Rating Scheme 3 combines both Rating Elements, but may result in more effort for the subject or more attention to the ratings themselves, thereby potentially introducing bias.

For the proposed Rating Schemes, see Figures 3 and 4.



Figure 2 – Rating Scheme 1 of main test procedure

**

Figure 3 – Rating Scheme 2 of main test procedure

**

Figure 4 – Rating Scheme 3 of main test procedure

##### 7.5.5.4.1 Required Rating Questions

At least one of the following questions must be asked:

* **Rating of initial loading experience (ILQ):**
  + Applies to Rating Element 1 and 2
  + Question: *How was the quality of your initial loading experience?* (See definition of “quality of initial loading experience”)
  + Possible Answers: ACR scale (1-5, including labels)
  + If the question is asked in Rating Element 1, the playback must not be interrupted by a rating screen shown in the interface, and subjects should give their scores verbally rather than writing down the scores on a sheet of paper.
* **Rating of overall quality (OVQ):**
  + Applies to Rating Element 2
  + Question: *What is your opinion of the overall quality?*
  + Possible Answers: ACR scale (1-5, including labels)

##### 7.5.5.4.2 Optional Rating Questions

The following further questions may be asked; these are optional. An example of optional questions is given below:

* Audiovisual quality (AVQ)
  + Applies to Rating Element 2 only
  + Question: *What was the quality of the audio and video?*
  + Answers: ACR scale (1–5, including labels)
* Loading acceptability (LA)
  + Applies to Rating Elements 1 and 2
  + *Was the initial loading delay acceptable?*
  + Answers: Binary (Acceptable, Unacceptable)

Further optional questions may be specified in a future Appendix to this recommendation.

An example of the ACR scale is given in Figure 3.

|  |  |
| --- | --- |
| 5 | Excellent |
| 4 | Good |
| 3 | Fair |
| 2 | Poor |
| 1 | Bad |

*Figure 5 - Rating scale (numerical values will be used in addition to the labels)*

ACR labels “Excellent” to “Bad” may be translated to the main language of the country in which the test is conducted. The numbers must be shown next to the scale labels.

After rating, the subject can continue with Step 1, unless there are no more videos to be rated.

#### 7.5.5.5 Content Rating Procedure

After completing the main test, subjects may be shown a list of source sequences they have seen, together with questions about the content. For example, subjects may be asked whether they liked a particular content, and may judge their opinion on a particular scale.

Examples of such questions are given below:

* *What were your expectations of the video content before watching it?*
* *How much did you like the content after having watched it?*
* Answers: ACR scale (1-5, including labels), or 5-star rating.

#### 7.5.5.6 Optional Questionnaire

An optional questionnaire may be shown to the subjects, which aims at gathering background information about their typical video streaming service or Internet usage. Appendix II gives an example of such a questionnaire.

## 7.6 Subjective Test Environment and Set-up

Two types of subjective tests may be carried out, either using PC (e.g, computer playback) or mobile equipment (e.g. mobile phone).

### 7.6.1 Common Properties

The following conditions must be met for both PC and mobile tests.

It should be ensured that:

1. playback mechanism is guaranteed to play at frame rate without dropping frames,
2. playback mechanism does not add visible artifacts,

The tests must be conducted indoors – see the following sections for detailed requirements.

### 7.6.2 PC Tests

PC tests will be conducted using a computer where test sequences are loaded from a hard disk and presented on a computer monitor.

#### 7.6.2.1 Test Environment

The test room shall conform to the requirements set out for controlled environments according to clause 8.1 in [ITU-T Rec. P.913].

#### 7.6.2.2 Display Specification and Set-up

The monitor must support at least Full-HD resolution (1920x1080).

The video sequences may be played in fullscreen mode, or in a smaller window, where they may be surrounded by UI elements of the simulated video platform. If played in fullscreen, the monitor must have an equal to or higher resolution than the highest resolution that is used in the test’s HRCs.

The display shall be set-up using the following procedure:

* Use the auto setting to set the default values for luminance, contrast and color shade of white.
* Adjust the brightness according to [Rec. ITU-T P.910], but do not adjust the contrast (it might change balance of the color temperature).
* Set the gamma to 2.2.
* Set the color temperature to 6500 K.

Any post-processing done by the monitor (e.g., frame interpolation, motion smoothing, …) must be deactivated.

#### 7.6.2.3 Viewing Distance

The instructions given to subjects will request subjects to maintain a specified viewing distance range from the display device, but overall maintain a comfortable viewing distance of their own choice.

The viewing distance range should correspond to about 1 minute of arc. For example, this equals to about 1.5H for UHD displays, or 3H for Full-HD displays, where H = height of the visible part of the display.

#### 7.6.2.4 Viewing Conditions

Only one subject should be seated in front of the viewing device.

The test room will conform to the requirements specified in clause 7.6.2.3.

It is recommended that subjects be seated facing the center of the video display at the specified viewing distance.

#### 7.6.2.5 Listening Conditions

Audio will be presented using headphones or speakers.

When listening is carried out with headphones, audio will be played using a diotic presentation (both ears receive the same mono signal) or binaural presentation (each ear receives one channel of a stereo signal). Headphones should be diffuse-field equalized headphones.

Artificial background noise (e.g. Hoth noise) will not be used.

Presentation (listening) level should be 73dB (SPL) at both ears when using headphones.

### 7.6.3 Mobile Equipment Tests

Mobile equipment audiovisual tests will be conducted using a mobile phone where test sequences are loaded from the phone’s internal memory.

The voting questions may be presented by one of the following means:

1. on the phone display
2. on a paper-based questionnaire

#### 7.6.3.1 Test Environment

The test room shall conform to the same specifications as in clause 7.6.2.1.

#### 7.6.3.2 Device Specification and Set-up

The test will be carried out on mobile phones. The devices may have specifications such as given in the following table.

Table 4 – Example Mobile Device Specifications

| **Device Feature** | **Device 1** | **Device 2** |
| --- | --- | --- |
| Diagonal display size | 5.1” | 5.7” |
| Display resolution | 2560 x 1440 | 2560 x 1440 |
| Display type | LCD | AMOLED |

The phone should be charged during the session to avoid depleting the battery.

#### 7.6.3.3 Viewing Distance

The viewing distance should be between 6–8H where H = display height (in landscape mode), according to subjects’ preference.

#### 7.6.3.4 Viewing Conditions

Only one subject should be seated in front of the viewing device.

The device should be mounted in landscape mode on a desk or wall. This will also help avoid fatigue. Cycle mounts are useful for this and can be mounted to an adjustable boom mic stand. Car mounts can be fixed on the table as well

To minimize dirt and greasy marks on the screen the screen should be wiped before each subject starts their test and during each break.

Subjects will be seated facing the device at a horizontal angle between 0 and 45°.

#### 7.6.3.5 Device Settings

Mobile devices may have default options turned on that can interfere with the test procedure. The following settings may require changes from factory defaults:

* Brightness: The device display must be set to the highest brightness level, or a level that is comfortable in the test environment. Automatic brightness correction must be disabled.
* Power saving: Any power or battery saving mode must be turned off.
* Display lock: The display must not lock automatically. Any screensavers must be disabled.
* Screen mode: If the device offers screen or color enhancement modes, these must be turned off or set to “Standard”. Depending on the device, such enhancement modes may be called “Adaptive Display”, “Dynamic”, “Professional”, “Photo”, or “Cinema”.
* Notifications: Notifications from applications on the phone must be disabled.

#### 7.6.3.6 Listening Conditions

See clause 7.6.2.5.

An audio extension lead may be used to avoid a heavy headphone connection directly into the phone.

## 7.7 Subjects and Subjective Test Control

### 7.7.1 Number of Subjects

At least 50 subjects should participate in each test. For a pilot-test, no fewer than 25 subjects should be used.

Subjects who have failed the pre-test will be allowed to continue, but their ratings must be checked for reliability.

It is recommended to have a 50-50 split or near 50-50 split between female and male subjects. If the parity between male and female participants cannot be achieved, then a maximum of 60-40 split is permitted.

It is recommended to include subjects from different socio-economic backgrounds.

Only non-expert subjects should participate. The term non-expert is used in the sense that the subjects’ work does not involve audio or picture quality and they are not experienced assessors. They must not have participated in a subjective quality test over a period of six months.

### 7.7.2 Subject Screening

Prior to participation in a video test, subjects must be screened for the following:

* Severe visual impairments
* Color blindness
* Failure to comprehend the written instructions (e.g., due to language deficiencies)
* Hearing loss

### 7.7.3 General Instructions for Subjects

A set of instructions that the test subject will have to read must be written down. The instructions must clearly explain why the test is being run, what the subject will see/hear, and what the subject should do. The instructions should be tested with non-experts to make sure they are clear, and must be revised as necessary.

The experimenter must ask the subject whether he/she has understood the instructions and clarify any remaining questions.

Detailed example instructions to subjects are provided in Appendix I.

Appendix I  
  
Example Instructions to Subjects

(This appendix does not form an integral part of this Recommendation.)

These instructions must be handed to the subjects in written form*.* They must be translated to the local language of the lab in which the tests are being conducted.

**Introduction:** Thanks for coming in today to participate in our study. The study is about a video-on-demand service; it is being sponsored and conducted by companies that are developing testing new technologies to enhance consumers' online video experience. These companies are interested in your view on the overall quality.

**Screening:** Please indicate if you have any problems seeing (including color blindness), hearing, or understanding *(the language in which the test is performed)*.

**Overall Goal:** We are going to ask you to browse a video-on-demand platform, select the videos you are interested in, and start to watch. Afterwards, we will ask you to judge each video’s loading time and quality – we will explain more below about what we mean by that. It takes time to load these videos; sometimes there may be loading problems, as you will probably have experienced them in real life. In case of loading problems, if the loading feels too long for you, you can abort the video playback *(Editor’s note: Insert specific instructions which button or UI element to press to abort)* and select another video.

**Setup:**

* When we get started with the study, please sit at *(location)*. The video-on-demand service will be displayed on the *(screen/phone)*.
* Please stay close to the position indicated by the mark. This is because the videos might look a little different from different positions, and we would like everyone to judge the videos from about the same position. Feel comfortable to move around a little bit though, if necessary.
* (*Optional for mobile tests:*) Please do not press any of the physical buttons on the phone. This may turn off the phone display or exit the test, making your ratings invalid.

**Process:**

* You will first see an overview of different video genres and thumbnails for each video that you can select.
* Please choose a video you would like to watch, then select the video by clicking on its thumbnail.
* Each video will be a few minutes long.
* **Rating *(optional)*:** As soon as the video has started playing, please rate the quality of your initial loading experience on the following scale: (*Picture of ACR scale).* Your task is to judge how well the delay you experienced between starting the selected video that you wanted to see, and the time that it took until you saw the video, met your expectations. *(Editor’s note: Depending on the Rating Scheme chosen, the question can also be asked after the video has finished; the text has to be modified in this case.)*
* **Rating:** Once the video has finished you should then rate the overall quality on the following scale: *(Picture of ACR scale).* Your task is to judge the *overall* *quality* of each sequence – not the content.Parts of the playback where the video is not playing and a waiting indicator is shown are part of the test.  Any variation of video and audio quality is also part of the test. You should consider both of these things as part of your overall quality judgment.
* This process will be repeated until you have seen and voted on (*insert number*) sequences, then we’ll have a break. Then there will be another similar session.

**Note:**

* Due to limited duration of the video, some videos may end abruptly in a middle of scene. Please do not consider this abrupt ending in your judgment.
* There is no wrong answer in this task; just rely on your own judgment.

**Practice:** At the start of the test the first sequences you see will be practice sequences so you can get a feel for the setup and how to make your ratings. After several of these practice sequences you will then be told when the test starts properly.

**Questions:** If you have questions, please ask the experiment leader.

**Subject Consent:** *(example, may be different for each lab)*The *(name of experiment)* Experiment is being conducted at the (*name of your lab*) lab. The purpose, procedure, and risks of participating in the *(name of experiment)* Experiment have been explained to me. I voluntarily agree to participate in this experiment. I understand that I may ask questions, and that I have the right to withdraw from the experiment at any time. I also understand that (*name of lab*) lab may exclude me from the experiment at any time. I understand that any data I contribute to this experiment will not be identified with me personally, but will only be reported as a statistical average.

Signature of participant Signature of experimenter

Name of participant Date Name of experimenter

Appendix II  
  
Test Questionnaire

(This appendix does not form an integral part of this Recommendation.)

In order to understand the subjects' background on video streaming usage, the following questionnaire may be asked after the main test procedure.

Q1. How fast is your internet connection at home? (Single select)

|  |  |
| --- | --- |
| Less than 2Mbps |  |
| 2~10Mbps |  |
| 10 ~ 50Mbps |  |
| 50 ~ 100Mbps |  |
| More than 100Mbps |  |
| Not sure |  |
| Do not have internet connection |  |

Q2. What generation of mobile network are you currently using on your smartphone? (Single select)

|  |  |
| --- | --- |
| 2G |  |
| 3G |  |
| 4G-LTE |  |
| Not sure |  |
| Do not use smartphone |  |

Q3a. What devices do you typically use for streaming video at home (Multi select)

|  |  |  |
| --- | --- | --- |
|  | Television |  |
|  | Tablet |  |
|  | Smartphone |  |
|  | Laptop |  |
|  | Personal Computer |  |
|  | Other, please specify\_\_\_\_\_ |  |

Q3b. What devices do you typically use for streaming video on the go (Multi select)

|  |  |  |
| --- | --- | --- |
|  | Television |  |
|  | Tablet |  |
|  | Smartphone |  |
|  | Laptop |  |
|  | Personal Computer |  |
|  | Other, please specify\_\_\_\_\_ |  |

Q4a. In the past 3 months, how often did you watch online videos via your mobile phone / PC? (Single select)

|  |  |  |
| --- | --- | --- |
|  | Less than once per day |  |
|  | Once per day |  |
|  | 2-3 times per day |  |
|  | 4-5 times per day |  |
|  | More than 5 times per day |  |

Q4b. In the past 3 months, on average how much time did you spend in a session when you watched online videos on your mobile phone / PC? (Single select)

|  |  |  |
| --- | --- | --- |
|  | Less than 5 minutes |  |
|  | 5-9 minutes |  |
|  | 10-19 minutes |  |
|  | 20-29 minutes |  |
|  | 30-59 minutes |  |
|  | 1-2 hours |  |
|  | More than 2 hours |  |

Q5. What is your favourite type of video? (Multi select)

|  |  |
| --- | --- |
| Movies, Movie trailers |  |
| TV Shows |  |
| Sports |  |
| Music video |  |
| Animation |  |
| News |  |
| Documentaries |  |
| Other, please specify\_\_\_\_\_ |  |

Appendix III  
  
Description of Pilot Test

(This appendix does not form an integral part of this Recommendation.)

This Annex describes a pilot test conducted by Huawei, which was designed in collaboration with TU Ilmenau in the Q.13 work item P.QUITS. Findings from this test were used for further development of the main body of this recommendation.

**Target:**

The pilot test aimed at capturing the user experience of initial loading delays during audiovisual streaming. The purpose of the pilot test includes three aspects:

1. Verifying the validity of the mobile test system
2. The subjective testing process is optimized
3. Preliminary results are analyzed; suggestions for the evaluation of the initial loading scores and future tests are made.

**Pilot Test Plan:**

In this pilot test, in order to study the user experience of initial loading of audiovisual streaming, the subjective experiment was designed with the following factors: initial loading delay, video duration, and video quality.

**Experimental Materials:**

There are 84 experimental sequences. SRCs include landscapes, food, outdoor sports, advertising, entertainment programs, and news interviews. The SRCs have 6 duration levels, which are 10s, 20s, 40s, 1min, 2min and 3min. Video resolution includes five levels of 320p, 480p, 720p, 1080p, and 1440p. The specific settings are shown in Table 1.

Table 1 Pilot Test SRC settings

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Resolution | Video duration /s | Num. | Resolution | Video duration /s | Num. |
| 320p | 10 | 3 | 720p | 60 | 3 |
| 320p | 20 | 3 | 720p | 120 | 3 |
| 320p | 40 | 3 | 720p | 180 | 2 |
| 320p | 60 | 3 | 1080p | 10 | 3 |
| 320p | 120 | 3 | 1080p | 20 | 2 |
| 320p | 180 | 3 | 1080p | 40 | 3 |
| 480p | 10 | 3 | 1080p | 60 | 3 |
| 480p | 20 | 3 | 1080p | 120 | 2 |
| 480p | 40 | 2 | 1080p | 180 | 3 |
| 480p | 60 | 3 | 1440p | 10 | 2 |
| 480p | 120 | 3 | 1440p | 20 | 3 |
| 480p | 180 | 3 | 1440p | 40 | 3 |
| 720p | 10 | 3 | 1440p | 60 | 2 |
| 720p | 20 | 3 | 1440p | 120 | 3 |
| 720p | 40 | 3 | 1440p | 180 | 3 |

**Pilot Test Platform and Test Environment:**

To assess the quality of initial loading experience, a subjective test system based on the Android mobile phone platform was developed. The pilot test system can control the initial loading delay and provide the subjects with video playbacks with different HRCs.

To ensure a close to real-world experience for the subjects, the pilot test system was made consistent with current mainstream video services. The mobile interface of the test system mainly simulates the interface of a major OTT video platform, as shown in Fig. 1.

Subjects select a video for full-screen playback and can then evaluate the quality of the video at the end. Experimental environment followed the settings in ITU-T Rec. P.911.



Fig. 1 (a) Main interface



Fig. 1 (b) Play interface

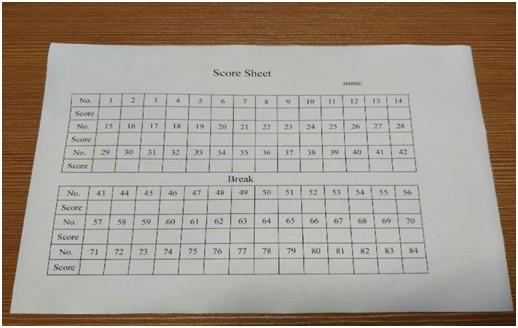


Fig. 2 (a) Score sheet for Rating Element 1

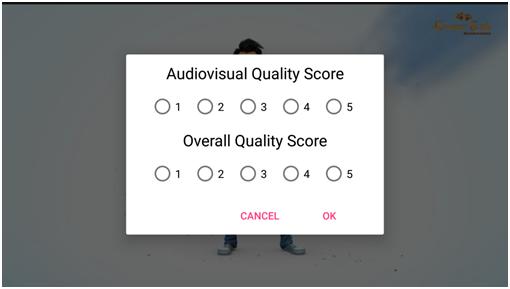


Fig. 2 (b) Scoring interface of Rating Element 2 – Option 1

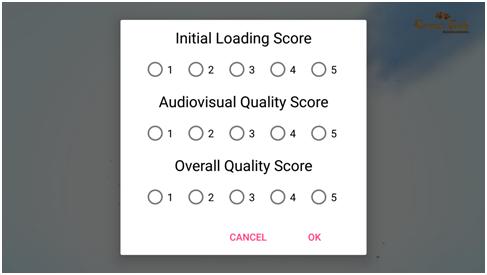


Fig. 2 (c) Scoring interface of Rating Element 2 – Option 2

**HRC Settings:**

The initial loading delay was set to fourteen levels of 0.1 s, 0.2 s, 0.3 s, 0.5 s, 0.7 s, 1 s, 2 s, 4 s, 6 s, 8 s, 10 s, 15 s, 20 s, and 30 s. There are six video sequences for each initial loading delay. The video resolution and video duration are randomly assigned to a total of 84 HRCs.

Table 2 Experimental HRCs

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| HRC | Initial loading delay (s) | Video duration | Resolution | HRC | Initial loading delay (s) | Video duration | Resolution |
| HRC1 | 0.1 | 10s | 320P | HRC43 | 0.1 | 1min | 320P |
| HRC2 | 0.2 | 10s | 480P | HRC44 | 0.2 | 1min | 480P |
| HRC3 | 0.3 | 10s | 720P | HRC45 | 0.3 | 1min | 720P |
| HRC4 | 0.5 | 10s | 1080P | HRC46 | 0.5 | 1min | 1080P |
| HRC5 | 0.7 | 10s | 1440P | HRC47 | 0.7 | 1min | 1440P |
| HRC6 | 1 | 10s | 320P | HRC48 | 1 | 1min | 320P |
| HRC7 | 2 | 10s | 480P | HRC49 | 2 | 1min | 480P |
| HRC8 | 4 | 10s | 720P | HRC50 | 4 | 1min | 720P |
| HRC9 | 6 | 10s | 1080P | HRC51 | 6 | 1min | 1080P |
| HRC10 | 8 | 10s | 1440P | HRC52 | 8 | 1min | 1440P |
| HRC11 | 10 | 10s | 320P | HRC53 | 10 | 1min | 320P |
| HRC12 | 15 | 10s | 480P | HRC54 | 15 | 1min | 480P |
| HRC13 | 20 | 10s | 720P | HRC55 | 20 | 1min | 720P |
| HRC14 | 30 | 10s | 1080P | HRC56 | 30 | 1min | 1080P |
| HRC15 | 0.1 | 20s | 1440P | HRC57 | 0.1 | 2min | 1440P |
| HRC16 | 0.2 | 20s | 320P | HRC58 | 0.2 | 2min | 320P |
| HRC17 | 0.3 | 20s | 480P | HRC59 | 0.3 | 2min | 480P |
| HRC18 | 0.5 | 20s | 720P | HRC60 | 0.5 | 2min | 720P |
| HRC19 | 0.7 | 20s | 1080P | HRC61 | 0.7 | 2min | 1080P |
| HRC20 | 1 | 20s | 1440P | HRC62 | 1 | 2min | 1440P |
| HRC21 | 2 | 20s | 320P | HRC63 | 2 | 2min | 320P |
| HRC22 | 4 | 20s | 480P | HRC64 | 4 | 2min | 480P |
| HRC23 | 6 | 20s | 720P | HRC65 | 6 | 2min | 720P |
| HRC24 | 8 | 20s | 1080P | HRC66 | 8 | 2min | 1080P |
| HRC25 | 10 | 20s | 1440P | HRC67 | 10 | 2min | 1440P |
| HRC26 | 15 | 20s | 320P | HRC68 | 15 | 2min | 320P |
| HRC27 | 20 | 20s | 480P | HRC69 | 20 | 2min | 480P |
| HRC28 | 30 | 20s | 720P | HRC70 | 30 | 2min | 720P |
| HRC29 | 0.1 | 40s | 720P | HRC71 | 0.1 | 3min | 1080P |
| HRC30 | 0.2 | 40s | 1080P | HRC72 | 0.2 | 3min | 1440P |
| HRC31 | 0.3 | 40s | 1440P | HRC73 | 0.3 | 3min | 320P |
| HRC32 | 0.5 | 40s | 320P | HRC74 | 0.5 | 3min | 480P |
| HRC33 | 0.7 | 40s | 480P | HRC75 | 0.7 | 3min | 720P |
| HRC34 | 1 | 40s | 720P | HRC76 | 1 | 3min | 1080P |
| HRC35 | 2 | 40s | 1080P | HRC77 | 2 | 3min | 1440P |
| HRC36 | 4 | 40s | 1440P | HRC78 | 4 | 3min | 320P |
| HRC37 | 6 | 40s | 320P | HRC79 | 6 | 3min | 480P |
| HRC38 | 8 | 40s | 480P | HRC80 | 8 | 3min | 720P |
| HRC39 | 10 | 40s | 720P | HRC81 | 10 | 3min | 1080P |
| HRC40 | 15 | 40s | 1080P | HRC82 | 15 | 3min | 1440P |
| HRC41 | 20 | 40s | 1440P | HRC83 | 20 | 3min | 320P |
| HRC42 | 30 | 40s | 320P | HRC84 | 30 | 3min | 480P |

**Pilot Test Procedure:**

For the initial loading experience, two kinds of subjective experimental test programs were designed, in order to obtain scores for the subject's initial loading experience at different stages of viewing the video (see Rating Elements 1 and 2 of the main recommendation text).

Through the analysis of experimental results, it is possible to determine which subjective test method (i.e. choice of questions in each Rating Element) reflect the subject's experience and provides a reasonable and effective experimental basis for subsequent proponents to conduct tests in a similar fashion.

By using the results of such subjective experiments, the relationship between the subject's quit rate and the initial loading delay, the influencing factors of the initial loading experience, and the relationship between the initial loading score and the overall quality of the viewing experience were analyzed.

According to the initial research goal, the experiment included two sessions: the first session was mainly used to compare two subjective test schemes, and identify what their impact on the measured initial loading experience is. The second session was chosen to select one of the schemes from the first session, to conduct more detailed experiments to study the impact the initial loading score on the subject’s overall experience.

* **Session 1**

This session was designed with two subjective experiment schemes:

* The first approach was to rate initial loading score immediately after the mobile started to play the video, and to rate the audiovisual quality and overall experience at the end of each video. The scoring method used the 5-point ACR scoring standard. The subject waited for the initial loading before viewing. If he or she felt that the initial waiting time was unacceptable, he or she could exit that video.
* The second approach was to evaluate the initial loading experience, the video quality, and the overall experience at the end of each video. The initial loading experience, the video quality, and the overall experience all used the 5-point ACR scoring standard. Similar to the first approach, if the subject could not accept the initial waiting time before watching, they could quit. Acceptability of loading time was also tested by writing the 2-valued scoring on a paper at the end of each video. It was later shown to have a very strong correlation with the quitting rate.

For the experiment, each HRC from Table 2 was selected with a video duration of 10s, 1min, and 3min for pilot testing. There are 14 initial loading time values and 5 quality levels, resulting in a total of 42 HRCs. Details of the setting are shown in Table 3. For each of the two schemes, 42 different video SRCs were used.

Table 3 HRC Settings in session 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| HRC | Initial loading delay(s) | Resolution | Video duration | HRC | Initial loading delay(s) | Resolution | Video duration |
| HRC1 | 0.1 | 320P | 10s | HRC50 | 4 | 720P | 1min |
| HRC2 | 0.2 | 480P | 10s | HRC51 | 6 | 1080P | 1min |
| HRC3 | 0.3 | 720P | 10s | HRC52 | 8 | 1440P | 1min |
| HRC4 | 0.5 | 1080P | 10s | HRC53 | 10 | 320P | 1min |
| HRC5 | 0.7 | 1440P | 10s | HRC54 | 15 | 480P | 1min |
| HRC6 | 1 | 320P | 10s | HRC55 | 20 | 720P | 1min |
| HRC7 | 2 | 480P | 10s | HRC56 | 30 | 1080P | 1min |
| HRC8 | 4 | 720P | 10s | HRC71 | 0.1 | 1080P | 3min |
| HRC9 | 6 | 1080P | 10s | HRC72 | 0.2 | 1440P | 3min |
| HRC10 | 8 | 1440P | 10s | HRC73 | 0.3 | 320P | 3min |
| HRC11 | 10 | 320P | 10s | HRC74 | 0.5 | 480P | 3min |
| HRC12 | 15 | 480P | 10s | HRC75 | 0.7 | 720P | 3min |
| HRC13 | 20 | 720P | 10s | HRC76 | 1 | 1080P | 3min |
| HRC14 | 30 | 1080P | 10s | HRC77 | 2 | 1440P | 3min |
| HRC43 | 0.1 | 320P | 1min | HRC78 | 4 | 320P | 3min |
| HRC44 | 0.2 | 480P | 1min | HRC79 | 6 | 480P | 3min |
| HRC45 | 0.3 | 720P | 1min | HRC80 | 8 | 720P | 3min |
| HRC46 | 0.5 | 1080P | 1min | HRC81 | 10 | 1080P | 3min |
| HRC47 | 0.7 | 1440P | 1min | HRC82 | 15 | 1440P | 3min |
| HRC48 | 1 | 320P | 1min | HRC83 | 20 | 320P | 3min |
| HRC49 | 2 | 480P | 1min | HRC84 | 30 | 480P | 3min |

* **Session 2**

Through the analysis of the results of the first session, it was decided to focus further studies on the first scheme, as it would lead to more critical ratings of the initial loading experience, which were of main interest to the researchers.

Session 2 used the methods in the first session to conduct more detailed experiments to study the impact of initial loading experience. HRCs in Table 2 with video durations of 20s, 40s, and 2 min were selected for testing. These videos included 14 initial loading delay delays and 5 quality levels, for a total of 42 HRCs. The distribution is shown in Table 4.

Table 4 HRC Settings in session 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| HRC | Initial loading delay (s) | Video duration | Resolution | HRC | Initial loading delay (s) | Video duration | Resolution |
| HRC15 | 0.1 | 20s | 1440P | HRC36 | 4 | 40s | 1440P |
| HRC16 | 0.2 | 20s | 320P | HRC37 | 6 | 40s | 320P |
| HRC17 | 0.3 | 20s | 480P | HRC38 | 8 | 40s | 480P |
| HRC18 | 0.5 | 20s | 720P | HRC39 | 10 | 40s | 720P |
| HRC19 | 0.7 | 20s | 1080P | HRC40 | 15 | 40s | 1080P |
| HRC20 | 1 | 20s | 1440P | HRC41 | 20 | 40s | 1440P |
| HRC21 | 2 | 20s | 320P | HRC42 | 30 | 40s | 320P |
| HRC22 | 4 | 20s | 480P | HRC57 | 0.1 | 2min | 1440P |
| HRC23 | 6 | 20s | 720P | HRC58 | 0.2 | 2min | 320P |
| HRC24 | 8 | 20s | 1080P | HRC59 | 0.3 | 2min | 480P |
| HRC25 | 10 | 20s | 1440P | HRC60 | 0.5 | 2min | 720P |
| HRC26 | 15 | 20s | 320P | HRC61 | 0.7 | 2min | 1080P |
| HRC27 | 20 | 20s | 480P | HRC62 | 1 | 2min | 1440P |
| HRC28 | 30 | 20s | 720P | HRC63 | 2 | 2min | 320P |
| HRC29 | 0.1 | 40s | 720P | HRC64 | 4 | 2min | 480P |
| HRC30 | 0.2 | 40s | 1080P | HRC65 | 6 | 2min | 720P |
| HRC31 | 0.3 | 40s | 1440P | HRC66 | 8 | 2min | 1080P |
| HRC32 | 0.5 | 40s | 320P | HRC67 | 10 | 2min | 1440P |
| HRC33 | 0.7 | 40s | 480P | HRC68 | 15 | 2min | 320P |
| HRC34 | 1 | 40s | 720P | HRC69 | 20 | 2min | 480P |
| HRC35 | 2 | 40s | 1080P | HRC70 | 30 | 2min | 720P |

**About the subjects:**

Twenty subjects were selected; each subject had normal vision.

Before the pilot test, the test procedure was explained to the subject. For the two pilot test schemes, three video samples with different initial loading delays and different video quality were selected to allow the subjects to be familiar with the operation of the test platform, the test process, and the scoring criteria.

After viewing the sample videos, the main test procedure was started. The distance between the subjects and screen was set to be 3H. To avoid fatigue, each session did not exceed 30 minutes. After each session, there was a 20 minutes rest. It was ensured that subjects would not be disturbed during the test.

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