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1 Introduction

1.1 Overview
This document is applicable to 3GPP system capable terminals. It defines user experience performance test methods for mobile equipment (ME). This document version covers the browser performance test cases, the system response performance test cases, system stability test cases, camera and image quality performance test cases.

1.2 Scope
This document lists test cases to help developers optimize the whole system user experience. For example, avoiding long waiting time or response latency for users, maintain a stable operation system while the device has been running for a long period or present photos with better image quality.

These test cases, outlining the rationale, initial configuration, test procedure and expected result, are non-binding and non-exclusive. Operators, terminal manufacturers and test houses are free to perform additional or alternative tests.

Additionally, these tests provide only the methodology but not a minimum required performance value. The performance results produced by the tests are intended to give benchmarks for the operators to use when comparing terminals. The required results are decided by operators individually.
### 1.3 Definition of Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP</td>
<td>Access Point</td>
</tr>
<tr>
<td>APK</td>
<td>Android Package Kit</td>
</tr>
<tr>
<td>APP</td>
<td>Application</td>
</tr>
<tr>
<td>Bpm</td>
<td>Beats per minute</td>
</tr>
<tr>
<td>DUT</td>
<td>Device Under Test</td>
</tr>
<tr>
<td>E-UTRA</td>
<td>Evolved Universal Terrestrial Access</td>
</tr>
<tr>
<td>Fps</td>
<td>Frames per second</td>
</tr>
<tr>
<td>GPRS</td>
<td>General Packet Radio Service</td>
</tr>
<tr>
<td>GSM</td>
<td>Global System for Mobile Communications</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
</tr>
<tr>
<td>LBS</td>
<td>Location Based Service</td>
</tr>
<tr>
<td>MMS</td>
<td>Multimedia Messaging Service</td>
</tr>
<tr>
<td>MO</td>
<td>Mobile Originated</td>
</tr>
<tr>
<td>MT</td>
<td>Mobile Terminated</td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
</tr>
<tr>
<td>PDCCH</td>
<td>Physical Downlink Control Channel</td>
</tr>
<tr>
<td>RAT</td>
<td>Radio Access Technology</td>
</tr>
<tr>
<td>RCS</td>
<td>Rich Communication Services</td>
</tr>
<tr>
<td>RSRP</td>
<td>Reference Signal Receiving Power</td>
</tr>
<tr>
<td>RSSI</td>
<td>Received signal strength indication</td>
</tr>
<tr>
<td>SINR</td>
<td>Signal to Interference plus Noise Ratio</td>
</tr>
<tr>
<td>SMS</td>
<td>Short Message Service.</td>
</tr>
<tr>
<td>UEX</td>
<td>User Experience</td>
</tr>
<tr>
<td>UI</td>
<td>User Interface</td>
</tr>
<tr>
<td>URL</td>
<td>Uniform Resource Locator</td>
</tr>
<tr>
<td>VoLTE</td>
<td>Voice over Long-Term Evolution</td>
</tr>
<tr>
<td>WCDMA</td>
<td>Wideband Code Division Multiple Access</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>Wireless Fidelity</td>
</tr>
<tr>
<td>WLAN</td>
<td>Wireless Local Area Network</td>
</tr>
</tbody>
</table>

### 1.4 Document Cross-References

<table>
<thead>
<tr>
<th>Ref</th>
<th>Document Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TS.09</td>
<td>GSMA PRD Battery Life Measurement and Current Consumption Technique</td>
</tr>
</tbody>
</table>
## 2 Browser UEX performance Test

### 2.1 Test Environment and configuration

#### 2.1.1 Test Scenarios Preparation

- A high-speed camera capable of shooting at a frame rate of \( \geq 200 \) fps is recommended to be used to record the screen refresh process during testing. The camera lens must be filled with mobile screen during testing, which means the camera will be using macro settings.
- An intranet HTTP server PC which would host “static” IP pages that could contain representative web pages that would be downloaded by the Smartphone. This server will be used for browser performance testing.
- A WLAN or a WLAN simulator, so that the tester can compare Smartphone performance under different network conditions. These can provide a repeatable test environment. The simulator will be used for browser performance testing.
- A computer with video player software to analyze the recorded operation process. The video player software should be able to playback the video frame by frame (e.g. QuickTime player, KMPlayer).
- A Metronome can be used to provide standard operation speed.

![Figure 1 The test scenario](image)

#### 2.1.2 Device Configuration

- The device display contrast / brightness shall be set to the default values as delivered from the factory.
- The device uses battery power or is connected to a power supply.
- The terminal screen is unlocked.
- No APPs are running in the background except for the application that will be tested. This would include push notifications for all applications which have been disabled.
- Test environment lighting:
  - Avoid strong or flickering light.
  - The light in the test lab should make the captured image clear enough to be analysed on the computer
- A wide range of input methodology is used for the tests. For example, terminals may have touch sensitive screens, scroll bars, external sliders, physical buttons, a stylus or speech recognition. Within the tests, the term "press to use" means to convey an input methodology.
- For browser performance testing:
The browser to be tested is the Smartphone’s original browser as supplied with the devices when sold.
The terminal WLAN function is enabled.
20 specified bookmarks are stored in the browser already. The stored bookmark should be the most popular websites, which are commonly visited by the public.
No APPs are running in the background except for the browser APP or the “AT&T Network Attenuator” APP. This would include push notifications for all applications which have been disabled.

2.1.3 Test network configuration

Smartphones perform differently under good and poor network condition. The devices should be tested under different network conditions and compared with other devices.

To provide a simple test network for a terminal, it is recommended to use a WLAN. To compare the Smartphone performance under different network conditions (e.g. WLAN transmit/receive power), two approaches are recommended:

One approach is to install the “AT&T Network Attenuator” APP on Smartphone. The “AT&T Network Attenuator” is an example application. The “Network Attenuator” application could control various network speed and congestion levels on the device which would help with analysing the devices performance under the good/bad network conditions.

An example network attenuator application instruction and installation package can be found on the following link: https://developer.att.com/blog/at-t-network-attenuator.

Another approach is to use a WLAN signal simulator to provide a repeatable test environment. The test environment, which is detailed in the GSMA TS.09 BLM PRD [1] enables the tester to control many aspects of the base station simulator or WLAN signal simulator and allows the user to configure the test environment for different transmission powers.

The WLAN network configurations are provided in this version. (The GSM/GPRS/WCDMA/E-UTRA network configuration will be provided in future versions). The WLAN parameters of the test bed AP are given as below: (Refer to the GSMA TS.09BLM PRD [1], Section 3.8). The Wi-Fi RSSI parameter can be configured for different network conditions.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mandatory Value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLAN standards</td>
<td>IEEE 802.11b/g/a/n or Wi-Fi CERTIFIED 11a, 11g and 11n depending on whether Wi-Fi CERTIFIED devices are going to be mandated in the tests.</td>
<td></td>
</tr>
<tr>
<td>WLAN frequency</td>
<td>Channels 1,6,11</td>
<td></td>
</tr>
<tr>
<td>(2.4 GHz)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WLAN frequency</td>
<td>Channel 36 (using a 20 MHz bandwidth)</td>
<td>Devices that support the 2.4 GHz and 5 GHz bands may be tested in each band</td>
</tr>
<tr>
<td>(5 GHz)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.1.4 Test web page

Five test webpages have been created together with their associated files. Before testing, download the files onto a local web server that is accessible to the terminal.

It is recommended to place the files in five different folders of the server so the page and its contents are reloaded instead of taken from the cache of the mobile device during the test.

The test webpages can be found in the links below:

- jiage.vicp.io:7500/test_webpage_1.html
- jiage.vicp.io:7500/test_webpage_2.html
- jiage.vicp.io:7500/test_webpage_3.html
- jiage.vicp.io:7500/test_webpage_4.html
- jiage.vicp.io:7500/test_webpage_5.html

The webpage open resource codes can be found in Github: https://github.com/GSMATerminals/Smartphone-Performance-Test-Case-Guideline-Public/tree/master/TS.29%20chapter%202-Webpage%20browser%20performance%20testing(test%20case%202.1.4)

Test pages are designed so that there is a clear visual indication on a terminal's UI when that web page has completely loaded.

2.2 Browser application set up time

2.2.1 Default Starting Page is a Blank Page Test

Description
To measure the average time taken between user activation of the browser and the browser reaching an active state: the untitled blank page is presented.

Reason for test
The time taken for the browser to start has an impact on user experience: a long start-up time is worse than a short start-up time. This test case evaluates the overall browser start-up time (without any content loading or rendering) to ensure users do not have to wait long for browser applications to start.

### Table 1: WLAN parameters of the test Access Point (AP)

<table>
<thead>
<tr>
<th>Authentication / Ciphering</th>
<th>WPA2</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEACON INTERVAL</td>
<td>100MS</td>
</tr>
</tbody>
</table>

Assumption is that this is WPA2-Personal as WPA2-Enterprise would require an authentication (AAA) server.
Initial Condition

The initial configuration is the same as defined in section 2.1.2. In addition, the default starting page for browser is set to be the untitled blank page. The cache for the browser and browsing history are cleared. No applications and services are to be running in the background.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Use the high speed camera to capture the operation process.
3. Press the web browser icon or launch button to start up the browser.
4. Playback the testing process captured by high speed camera and analyse frame by frame. Record the time it takes from FINISHING pressing the browser icon or launch button, to when the untitled blank webpage is displayed completely.
5. Close the webpage, clear the browser cache and close the browser application in the Smartphone background.
6. Repeat test steps 2 through to 4 ten times, with a short break of ten seconds, to obtain an average application set up time.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

Additional Notes

In this test case, the blank default starting page means the untitled webpage interface where the user could search or type a URL. Different Smartphone UIs display varied blank starting pages. For example, Chrome shows some popular links on the start-up webpage; Safari shows the white blank page.

2.2.2 Default starting page is the last page visited test

Description

To measure the average time taken between user activation of the browser and the browser reaching an active state and the most recently visited webpage is presented.

Reason for test

The time taken for the browser to start has an impact on the user experience. A long start-up time is less acceptable than a short start-up time. This test case evaluates the overall browser start-up time (with content loading or rendering) to ensure users do not have to wait too long for the browser application to start.

Initial Condition

- The initial configuration is the same as defined in section 2.1.2. In addition, the default starting page of the browser is set to be the page that is most recently visited. No applications are running in the background.
Test Procedure

1. The user interface of the Smartphone is opened.
2. Press the web browser icon or launch button to start up the browser.
3. Enter the URL in the address bar to open the test web page.
4. Close the webpage and exit the browser application.
5. Use the high speed camera to capture the operation process.
6. Press the web browser icon or the launch button to start up the browser.
7. Playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from FINISHING pressing the browser icon or launch button, to when the webpage has completed loading.
8. Close the webpage, clear the cache and exit the browser application.
9. Repeat the test steps 5 through to 8 ten times, with a short break of ten seconds, to obtain an average application set up time.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

2.3 Web page zoom speed performance

The following test cases are designed for different mechanisms of a zooming UI action. The test case 3.4.1, 3.4.2 and 3.4.3 are alternatives and should be used depending on the support by the terminal browser.

2.3.1 Zoom mechanism: 2-finger press test

Description

Testing the terminal's overall response speed, when the user zooms in/out on one opened web page.

Reason for test

To ensure the users do not have to wait too long when zooming in/out on a webpage.

Initial condition

The initial configuration is the same as defined in section 2.1.2.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Open the browser application and load the test web page completely.
3. Use a high speed camera to capture the process.
4. Press the Smartphone screen and zoom in on the webpage. The content on screen becomes stable indicating that the webpage has finished zooming in.
5. Playback the testing process captured by the high speed camera and analyse frame by frame. Record the time point as T1 when the fingers finish sliding out. Record the time point as T2 when the webpage finishes zooming in.
6. Obtain the webpage zoom in speed by calculating the time difference between T1 and T2.
7. Press the Smartphone screen and zoom out from the webpage. The content on screen becomes stable indicating that the webpage has finished zooming out.
8. Playback the testing process captured by high speed camera and analyse frame by frame. Record the time point as T3 when the fingers finish sliding out. Record the time point as T4 when the webpage finishes zooming out.
9. Obtain the webpage zoom out speed by calculating the time difference between T3 and T4.
10. Repeat the tests step 3 through to 9 ten times, with a short break of ten seconds, to obtain an average webpage zoom in/out speed.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

**Additional Notes**

Define a standard input sliding speed to reduce the impact from user habit. The metronome could provide testers with a standard speed. 90 bpm (beats per minute) is suggested as a recommendation for zoom in/out speed. Another approach is to use an automated mechanism to operate the Smartphone.

The following is an example recommendation for the finger moving range during zooming in on the webpage;

Start from the middle of the screen, the sliding distance for each finger is approximately 50% of the screen width, and the movement should be at approximately 45degrees, to avoid either finger reaching the screen edge. It is recommended to use an automated mechanism to operate the Smartphone. The procedure for zooming out is vice-versa.

**Figure 2 Zoom in illustration**
2.3.2 Zoom mechanism: application zoom button test

Description

Testing the terminal response speed, when the user zooms in/out on an opened web page. The zoom mechanism is a one press zoom button.

Reason for test

To ensure users do not have to wait too long when zooming in/out on a webpage.

Initial condition

The initial configuration is the same as defined in section 2.1.2.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Open the browser application and load the test web page completely.
3. Use a high speed camera to capture the process.
4. Press the application zoom button on the webpage to zoom in the webpage. It indicates the webpage has finished zooming in when the content on screen becomes stable.
5. Playback the testing process captured by high speed camera and analyse frame by frame. Record the time as $T_1$ when the finger finishes pressing the zoom button. Record the time point as $T_2$ when the webpage has finished zooming in.
6. Obtain the webpage zoom in speed by calculating the time difference between $T_1$ and $T_2$.
7. Press the application zoom button on the webpage to zoom out the webpage. It indicates the webpage has finished zooming out when the content on the screen becomes stable.
8. Playback the testing process captured by a high speed camera and analyse frame by frame. Record the time as $T_3$ when the finger finishes pressing the zoom button. Record the time point as $T_4$ when the webpage finishes zooming out.
9. Obtain the webpage zoom out speed by calculating the time difference between $T_3$ and $T_4$.
10. Repeat the test steps 4 through to 9 ten times, with a short break of ten seconds, to obtain an average webpage zoom in/out speed.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

2.3.3 Zoom mechanism: double-click the screen test

Description

Testing the terminal response speed when the user zooms in/out of an opened web page. The zoom mechanism is: double-click on the screen.
Reason for test

To ensure users do not have to wait long when zooming in/out webpage.

Initial Condition

The initial configuration is the same as defined in section 2.1.2.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Open the browser application and load the test webpage completely.
3. Use a high speed camera to capture the process.
4. Double-click the Smartphone screen with an input device to zoom in the webpage. The webpage has finished zooming in when the content on the screen becomes stable.
5. Playback the testing process captured by a high speed camera and analyse frame by frame. Record the time as $T_1$ when the input device finishes. Record the time point as $T_2$ when the webpage finishes zooming in.
6. Obtain the webpage zoom in speed by calculating the time difference between $T_1$ and $T_2$.
7. Double-click the Smartphone screen with an input device to zoom out of the webpage. It indicates the webpage has finished zooming out when the content on screen becomes stable. Record the time as $T_3$ when the input device finishes.
8. Playback the testing process captured by a high speed camera and analyse frame by frame. Record the time as $T_3$ when the finger finishes pressing the screen. Record the time point as $T_4$ when the webpage finishes zooming out.
9. Obtain the webpage zoom out speed by calculating the time difference between $T_3$ and $T_4$.
10. Repeat the test steps 4 through to 9 ten times, with a short break of ten seconds, to obtain an average webpage zoom speed.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

2.4 Web page zoom frame rate performance

The following test cases are designed for different mechanism of zooming action. The test case 2.4.1, 2.4.2 and 2.4.3 are alternatives, depending on which is supported by the device browser.

2.4.1 Zoom performance: 2-finger press test

Description

Testing the terminal overall response performance (frame rate) when the user zooms in/out of an opened webpage with a 2-finger press.

Reason for test
To ensure the Smartphone provides a user with a smooth zoom in/out performance. The Smartphone screen refreshes at 60 fps uniformly in theory during zoom in/out. If the zoom in/out process is not fluent or blocked, the screen refresh rate will be less than the theoretical value.

**Initial Condition**

The initial configuration is the same as defined in section 2.1.2.

**Test Procedure**

1. The user interface of the Smartphone is opened.
2. Open the browser application and load the test webpage completely.
3. Set a high speed camera to capture the zoom in/out procedure.
4. Press Smartphone screen with two fingers then slide out the fingers to zoom in the webpage.
5. The content on screen becomes stable indicates the webpage finished zooming in.
6. Press the outer area of the Smartphone screen with two fingers then slide in the fingers to zoom out the webpage.
7. The content on screen becomes stable indicates the webpage has finished zooming out.
8. Calculate the actual frame rate (fps) during the captured zoom in/out procedure.

**Frame rate (”a” fps) measurement recommendation:**

- Playback the high speed camera captured test process frame by frame (Frame Rate of camera is assumed to be “Y” fps).
- Watch the video to find the point when the display starts zooming and record the frame number as $F_1$. Find the point when the display finishes zooming and record the frame number as $F_2$.
- Calculate the duration of zoom as: $t = (F_2 - F_1)/Y$ seconds.
- The screen refresh process: The captured video shows one clear image when the screen starts to refresh, a few blurred images will be shown until the screen refreshes next time. When the next clear image appears on the captured video, the screen starts to refresh again. Within this interval “t”, pick out the frames that show the screen has completely refreshed. Count the number of refresh frames (assumed to be $A$).
- Then the average actual frame rate during zooming can be calculated by the equation: Actual Frame Rate $a= A/t$.

9. Repeat the test steps 4 to 8 ten times, with a short break of ten seconds, to obtain an average webpage zoom in and zoom out frame rate.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

**Additional Notes**
Define standard finger sliding speed to reduce the impact from the user habit. The metronome could provide testers with a standard speed, 90 bpm is suggested as a recommendation for finger zoom in/out speed. Another approach is to use an automated mechanism operating the Smartphone.

The following is an example recommendation for the finger moving range:

Start from the middle of the screen. The slide distance for each finger is approximately 50% of the screen width, and the movement should be at approximately 45 degrees, to avoid either finger reaching the screen edge. It is recommended to use an automated mechanism to operate the Smartphone. The procedure for zooming out is vice versa.

![Figure 4 Zoom in illustration](image)

![Figure 5 Zoom out illustration](image)

2.4.2 **Zoom performance: application zoom button test**

**Description**

Testing the terminal performance (frame rate) when a user zooms in/out of an open web page.

**Reason for test**

To ensure the Smartphone provides the user with a smooth zoom in/out performance. In theory, the Smartphone screen refreshes 60 fps uniformly during zooming in/out. If the zoom in/out process is not fluent or blocked, the screen refresh rate will be less than the theoretical value.

**Initial Condition**

The initial configuration is the same as defined in section 2.1.2.

**Test Procedure**
1. The user interface of the Smartphone is opened.
2. Open the browser application and load the test web page completely.
3. Set a high speed camera to capture the zoom in/out procedure.
4. Press the application zoom button on the webpage to zoom in the webpage.
5. The content on the screen becomes stable indicating the webpage has finished zooming in.
6. Press the application zoom button on the webpage to zoom out of the webpage.
7. The content on the screen becomes stable indicating the webpage has finished zooming out.
8. Calculate the actual frame rate (frames per second) during the captured zoom in/out procedure.

Frame rate ("a" fps) measurement recommendation:

- Playback the high speed camera captured test process frame by frame (Frame Rate of camera is assumed to be “Y” fps).
- Watch the video to find the point when the display starts zooming and record the frame number as $F_1$. Find the point when the display finishes zooming and record the frame number as $F_2$.
- Calculate the duration of zoom as: $t = (F_2 - F_1)/Y$ seconds
- The screen refreshing process: The captured video shows one clear image when the screen starts to refresh. A few blurred images will be shown until the screen refreshes the next time. When the next clear image appears on the captured video, the screen has started to refresh again. Within this interval “t”, pick out the frames that show the screen is refreshed. Count the number of refresh frames (assumed to be A).
- The average actual frame rate during zooming can be calculated by the equation: Actual Frame Rate $a = A/t$.

9. Repeat the test steps 4 through to 8 ten times, with a short break of ten seconds, to obtain an average webpage zoom in and zoom out frame rate.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

**2.4.3 Zoom performance: double-click the screen test**

**Description**

Testing the terminal performance (frame rate) when the user zooms in/out of an open webpage with a double click mechanism.

**Reason for test**

To ensure the Smartphone provides the user with a smooth zoom in/out performance. In theory, the Smartphone screen refreshes 60 fps uniformly during zoom in/out. If the zoom in/out process is not fluent or blocked, the screen refresh rate will be less than the theoretical value.
Initial Condition

The initial configuration is the same as defined in section 2.1.2.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Open the browser application and load the test webpage completely.
3. Set a high speed camera to capture the zoom in/out procedure.
4. Double-click the Smartphone screen with an input device to zoom in the webpage.
5. The content on screen becomes stable indicating the webpage has finished zooming in.
6. Double-click the Smartphone screen with an input device to zoom out the webpage.
7. When the content on the screen becomes stable, the webpage has finished zooming out.
8. Calculate the actual frame rate (frames per seconds) during the captured zoom in/out procedure.

Frame rate ("a" fps) measurement recommendation:

- Playback the high speed camera captured test process frame by frame (Frame Rate of camera is assumed to be “Y” fps).
- Watch the video to find the point when the display starts zooming and record the frame number as \( F_1 \). Find the point when the display finishes zooming and record the frame number as \( F_2 \).
- Calculate the duration of zoom as:
  \[ t = \frac{F_2 - F_1}{Y} \text{ seconds} \]
- The screens refresh process: The captured video shows one clear image when the screen starts to refresh. A few blurred images will be shown until the screen refreshes next time. The next clear image appears on the captured video when the screen has to be refreshed again. Within this interval “t”, pick out the frames that show the screen refreshed. Count the number of refresh frames (assumed to be A).
- The average actual frame rate during zooming can then be calculated by the equation: Actual Frame Rate \( a = \frac{A}{t} \).

9. Repeat the test steps 4 through to 8 ten times, with a short break of ten seconds, to obtain an average webpage zoom in and zoom out frame rate.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

2.5 Web page rotation speed performance

The following test case is designed for terminals which support web page rotation.

2.5.1 Rotation speed performance test

Description
Opening and fully loading one specified web page, testing the web page rotation response speed when the screen is switched from a horizontal position to a vertical position.

Reason for test

To ensure the Smartphone provides the user with a smooth rotational performance when using the browser.

Initial Condition

- The initial configuration is the same as defined in section 2.1.2.
- In addition, the screen is set to be able to rotate. The terminal is placed vertical (90 degrees) to the local ground.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Open the browser application and load the test web page completely.
3. Set a high speed camera to capture the rotation procedure.
4. Rotate the terminal from a vertical to horizontal orientation in a clockwise direction. The content on the screen becomes stable indicating the webpage has finished its rotation.
5. Playback the testing process captured by a high speed camera and analyse frame by frame. Record the time point as T₁ when the device completes position switch. Record the time point as T₂ when the webpage finishes rotation.
6. Obtain the webpage rotation speed by calculating the time difference between T₁ and T₂.
7. Apply the same method to obtain the rotation speed when the webpage is rotated from horizontal to vertical orientation in a clockwise direction.
8. Apply the same method for the test steps 3 through to 6 again when the terminal is rotated in an anticlockwise direction.
9. Repeat the test steps 4 through to 8 ten times, with a short break of ten seconds, to obtain an average webpage rotation speed.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

Additional Notes

The illustrations for terminal vertical/horizontal rotation are shown in figures 6 and 7. Define a standard device rotation speed to reduce the impact from the user. The metronome could provide testers with a standard speed. 90 bpm is suggested as a recommendation for device rotation speed. Another approach is to use an automated mechanism to operate the Smartphone.
2.6 Web page scrolling performance

The following test case is designed for terminals which support web page scrolling.

2.6.1 Web page scrolling performance test

Description

Testing the performance when the user scrolls up/down with an opened webpage.

Reason for test

To ensure the Smartphone provides the user with a smooth scroll up/down performance. In theory the Smartphone screen refreshes 60 fps uniformly during zooming in/out and the frame interval variance will be zero. If the zoom in/out process is not fluent or blocked, the screen refresh rate will be less than the theoretical value and the refresh frame interval variance will be greater than zero.

Initial Condition

The initial configuration is the same as defined in section 2.1.2.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Open the browser application and load the test webpage completely.
3. Set a high speed camera to capture the scroll procedure.
4. Slide the webpage on the Smartphone screen with an input device.
5. Calculate the average frame rate ("a" fps) according to the captured webpage scroll procedure.

Frame rate ("a" fps) measurement recommendation:

- Playback the high speed camera captured test process frame by frame (Frame Rate of camera is assumed to be “Y” fps).
- View the video to find the point when the input device starts sliding the screen and record the frame number as \( F_1 \). Find the point when the display finishes scrolling and record the frame number as \( F_2 \).
- Calculate the duration of scroll as:
  \[ t = \frac{F_2 - F_1}{Y} \] seconds
- The screen refreshing process: The captured video shows one clear image when the screen starts to refresh. A few blurred images will be shown until the screen has refreshed. The next clear image appears on the captured video when the screen starts to refresh. Within this interval “t”, pick out the frames that show the screen has refreshed. Count the number of refresh frames (assumed to be A).
- The average actual frame rate during scrolling can be calculated by the equation:
  \[ \text{Actual Frame Rate} \ a = \frac{A}{t} \]

6. Calculate the frame interval variance (\( \delta^2 \)) according to the captured webpage scroll procedure video.

Frame interval variance (\( \delta^2 \)) measurement recommendation:

- Playback the high speed camera captured test process frame by frame.
- Watch the video to pick out the refreshing frames. Calculate the time interval (\( \Delta T_1, \Delta T_2, \Delta T_3, \ldots \)) between these refreshing frames.
- If the theory frame rate is 60, then the theory average frame interval (\( \Delta T \)) is 14.3ms, which can be considered as the variance centre.
- The frame interval variance during scrolling can be explained by the equation:
  \[ \delta^2 = \sum (\Delta T - \Delta T_{1,2,3,\ldots})^2 \]

7. Repeat the test steps 4 through to 6 ten times, with a short break of ten seconds, to obtain an average webpage scroll performance.

**Expected Result**

For the frame rate, the higher the better. For the frame interval variance, the lower the better. The value requirement is decided by individuals.

**Additional Notes**

Define standard scroll speed to reduce the impact from the user. The metronome could provide testers with a standard speed - 90 bpm is recommended as a scroll speed for fingers. Another approach is to use an automated mechanism to operate the Smartphone.

The following is an example recommendation for the input device moving range:
Start point: 25% screen length to the bottom, end point: 25% screen length to the top. The user should not release the input device from the screen. If the user releases the screen, touch events will cease sending and the "scroll animator" may coast. This will change the frame rate. It is recommended to use an automated mechanism to operate the Smartphone. The procedure for scrolling down is vice-versa.

![Figure 8 Scroll down illustration](image)

![Figure 9 Scroll up illustration](image)

### 2.7 Webpage loading times

#### 2.7.1 Page loading time test

**Description**

The testing time between the start of opening a test webpage and displaying the entire page.

**Reason for test**

To ensure users do not have to wait too long when opening one webpage.

**Initial Condition**

The initial configuration is the same as defined in section 2.1.2. In addition, ensure the cache of the browser is empty.

**Test Procedure**

1. The user interface of the Smartphone is opened.
2. Use the high speed camera to capture the process.
3. Press the web browser icon or launch button to start up the browser.
4. Enter the URL of the test webpage at the address bar and then press the open button to load the webpage.
5. Playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from FINISHING pressing the browser icon or launch button to when the whole webpage has completed loading.

6. Close the webpage and exit the browser application in the Smartphone background.

7. Clear the browsing history and cache of the browser.

8. Repeat the test steps 2 through to 7 ten times, with a short break of ten seconds, to obtain an average webpage loading time.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

2.8 Backing up one history page test

2.8.1 Backing up History page test

**Description**

Testing the time between backing-up/forwarding one history page and displaying the page.

**Reason for test**

To ensure users do not have to wait too long when opening a formerly visited website.

**Initial Condition**

The initial configuration is the same as defined in section 2.1.2.

**Test Procedure**

1. The user interface of the Smartphone is opened.
2. Use the high speed camera to capture the process.
3. Press the web browser icon or launch button to start up the browser.
4. Enter URL of the **testing webpage 1** at the address bar to open the webpage.
5. Press the back button to reload the testing webpage 1.
6. After the testing webpage is loaded completely, enter the URL of another testing webpage 2 at the address bar to open a second webpage.
7. Playback the testing process captured by a high speed camera and analyse frame by frame. Record the time it takes from finishing pressing the back button to when the testing webpage 1 completes there loading.
8. Close the webpage, clear the cache and exit the browser application in the Smartphone background.
9. Clear the browser history and cache.
10. Repeat the test steps 2 through to 9 ten times, with a short break of ten seconds, to obtain an average history webpage loading time.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.
2.9 Multiple web-page switching speed

The following test case is designed for browsers on terminals which support multiple open web pages at the same time.

2.9.1 Web-Page switching speed test

Description

Open several web pages by one browser and switch between different browser tabs to measure the switching speed.

Reason for test

The multi-page switching performance is related to the Smartphone browser cache read performance. To ensure users do not have to wait too long when switching between websites.

Initial Condition

The initial configuration is the same as defined in section 2.1.2. In addition, the browser is able to open several webpage (tabs) at the same time.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Press the web browser icon or launch button to start up the browser.
3. Enter the URL of the testing webpage 1 at the address bar to open the webpage.
4. Add a new tab in the browser when the testing webpage 1 is loaded completely.
5. On the newly opened tab, enter the URL of the testing webpage 2 in the address bar to open the webpage.
6. Repeat test steps 4 and 5 to open five different webpage.
7. Press the browser tab switcher icon in order to scroll through five tabs.
8. Choose one of those five webpage then click to switch to that webpage.
9. Record the time point as T1 when the input device finishes clicking the screen for webpage switching.
10. Record the time point as T2 when the chosen page is loaded completely.
11. Calculate the multi-page switching time by taking the time difference between T1 and T2. The high speed camera is recommended to capture the process.
12. Choose different webpage from these five tabs and then repeat the test steps 7 through to 11 ten times, with a short break of ten seconds, to obtain an average multi-page switching time.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.
2.10 Web-page multimedia play performance

The following test case is designed for browsers on terminals which support multimedia applications (e.g. video).

- Note: Different terminals buffer an initial frame of a video sequence in different ways. Some mechanisms load the initial frame quickly to introduce a video, by displaying that initial frame, and then load the rest of the other frames whilst other mechanisms display a blank screen, loading many of the frames before starting. This is a trade-off between displaying the first frame and buffering the rest. This difference in operation can distort the results of the following test between differing terminals and is not necessarily representative of the video loading time.

2.10.1 Video loading time test

Description

Using the browser, open one specified webpage containing different formats of video stream links. Playback the video and then measure the time to show the first frame of the video.

Reason for test

The time taken for the browser to play the video has an impact on the user experience, a shorter waiting time is preferred. This test case evaluates the browser video first frame play time to ensure users do not have to wait too long.

Initial Condition

The initial configuration is the same as defined in section 2.1.2. In addition, the video player to be tested is built-in inside the browser. The testing webpage is loaded onto a local server to avoid the influence of network instability.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Press the web browser icon or launch button to start up the browser.
3. Clear the browser cache and browsing history.
4. Enter the URL of the testing webpage 1 at the address bar to open the webpage.
5. Click the video playback button.
6. Record the time it takes from finishing pressing the playback button, to when the video shows the first frame. The high speed camera should be used to capture the process.
7. Stop playing the video.
8. Repeat test steps 3 through to 7 ten times, with a short break of ten seconds, to obtain the average video loading time.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.
2.10.2 Video playback performance test

Description

Using the browser to open one specified webpage, which contains different video formats in video streaming links. Playback the video and then measure the average frame rate of the video.

Reason for test

To ensure the Smartphone browser provides users with a smooth video playback performance.

Initial Condition

The initial configuration is the same as defined in section 2.1.2. In addition, the video player to be tested is embedded inside the browser. The testing webpage is loaded onto a local server to avoid the influence of network instability.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Press the web browser icon or launch button to start up the browser.
3. Clear the browser cache and browsing history.
4. Enter the URL of the testing webpage at the address bar to open the webpage.
5. Click the video playback button.
6. Set a high speed camera to capture the procedure.
7. Calculate the average frame rate according to the captured video.

Frame rate ("a" fps) measurement recommendation:

- Playback the high speed camera captured test process frame by frame.
- Assume the video playback time is "t".
- The screen refreshing process: The captured display shows one clear image when the screen starts to refresh. A few blurred images will be shown until the screen refreshes. When the next clear image appears on the captured display, the screen has started to refresh again. Within this interval "t", pick out the frames that show the screen refreshing. Count the number of refresh frames (assumed to be “A”).
- The average video playback frame rate can be explained by the equation: \( a = \frac{A}{t} \).
8. Calculate the frame interval variance (\( \delta^2 \)) according to the captured video procedure.

Frame interval variance (\( \delta^2 \)) measurement recommendation:

- Playback the high speed camera captured test process frame by frame.
- Watch the video to pick out the refreshing frames. Calculate the time interval (\( \triangle T_1, \triangle T_2, \triangle T_3, \ldots \)) between these refreshing frames.
- The theoretical frame rate is “V”, the average frame interval (\( \triangle T \)) is \( 1/V \) s, which can be considered as the variance centre.
The frame interval variance during multimedia play can be explained by the equation:

\[ \delta^2 = \sum (\Delta T - \Delta T_{(1,2,3,\ldots)})^2 \]

9. Repeat the test steps 3 through to 8 ten times, with a short break of ten seconds, to obtain the webpage video playback performance.

Expected Result

For the frame rate, the higher the better. For the frame interval variance, the lower the better. The value requirement is decided by individuals.

3 System response performance testing

3.1 Test Environment and configuration

3.1.1 Device configuration

For system response performance testing, the following are required:

- 800 contacts shall be created as follows:
  - Contact Name. Example – Fred Blogs
  - Contact Phone Number. Example - +66 6781 001 001
  - Contact Email address. Example – fblogs@google.com
  - Contact Address - No.26 telecom road, Human city, Thailand

- 1000 SMS messages shall be created. These shall be between 10 and 20 word long.

- 60 emails shall be created as follows.
  - 30 emails with a pdf, MS Word, MS Power Point or MS Excel document attachment, the size shall be less than 1Mb. It is suggested to use this TS.29 document as the attachment.
  - 30 emails with a 3Mb photo attached. The photo could be downloaded from the photo material link below.
  - Example email text.
    - Dear Sir,
      This is the specified email text for UEX testing. This is the specified email text for UEX testing. This is the specified email text for UEX testing. This is the specified email text for UEX testing. This is the specified email text for UEX testing. This is the specified email text for UEX testing. This is the specified email text for UEX testing. This is the specified email text for UEX testing. This is the specified email text for UEX testing.
      Best regards, Mr Blogs 31st February 2000
  - 200 photos shall be created using the following example photos
    https://github.com/GSMATerminals/Smartphone-Performance-Test-Case-Guideline/Public/tree/master/TS.29%20chapter%203-
3.1.2 Test network configuration

It is suggested to use a signal simulator to provide a repeatable test environment. The LTE network configuration, provided below, enables the tester to control many aspects of the base station simulator or signal simulator. (Refer to the GSMA TS.09 BLM PRD [1], Section 3.7). The GSM/GPRS/WCDMA network configuration method, which also takes reference to the TS.09, will be updated in future versions.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Recommended Value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serving Cell Downlink EARFCN</td>
<td>Mid-range for all supported E-UTRA bands</td>
<td>All bands supported by the handset must be measured. Results must indicate which band(s) have been measured, and individual results for each band</td>
</tr>
<tr>
<td>Number of neighbours declared in the neighbour cell list</td>
<td>16 intra-frequency, 0 inter-frequency, 0 inter-RAT, no MBSFN cells</td>
<td>Although the mobile is required to monitor these neighbour cells, the test equipment does not in fact provide signals.</td>
</tr>
<tr>
<td>DRX Cycle</td>
<td>1.28 seconds</td>
<td>Results must indicate the used DRX Cycle.</td>
</tr>
<tr>
<td>Periodic TAU</td>
<td>No</td>
<td>T3412 = 111xxxxx</td>
</tr>
<tr>
<td>Reference Signal Energy Per Resource Element (RS)</td>
<td>-85 dBm/15kHz</td>
<td>Refer to 3GPP TS 36.521-1.,C.0 Default value used for 3GPP performance test setup and signalling tests.</td>
</tr>
<tr>
<td>$N_{oc}$</td>
<td>-98dBm/15kHz</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Recommended Value</td>
<td>Comment</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Uplink downlink configuration</td>
<td>NA</td>
<td>1 Refer to 3GPP TS36.521-1,C.2</td>
</tr>
<tr>
<td>Special sub frame configuration</td>
<td>NA</td>
<td>4</td>
</tr>
<tr>
<td>PBCH EPRE Ratio</td>
<td>PBCH_RA = 0 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PBCH_RB = 0 dB</td>
<td></td>
</tr>
<tr>
<td>PSS EPRE Ratio</td>
<td>PSS_RA = 0 dB</td>
<td></td>
</tr>
<tr>
<td>SSS EPRE Ratio</td>
<td>SSS_RA = 0 dB</td>
<td></td>
</tr>
<tr>
<td>PCFICH EPRE Ratio</td>
<td>PCFICH_RB = 0 dB</td>
<td></td>
</tr>
<tr>
<td>PDCCH EPRE Ratio</td>
<td>PDCCH_RA = 0 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDCCH_RB = 0 dB</td>
<td></td>
</tr>
<tr>
<td>PDSCH EPRE Ratio</td>
<td>PDSCH_RA = 0 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDSCH_RB = 0 dB</td>
<td></td>
</tr>
<tr>
<td>PHICH EPRE Ratio</td>
<td>PHICH_RA = 0 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PHICH_RB = 0 dB</td>
<td></td>
</tr>
<tr>
<td>Serving cell bandwidth</td>
<td>10 MHz</td>
<td></td>
</tr>
<tr>
<td>Number of antenna ports at eNodeB</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Cyclic Prefix Length</td>
<td>Normal</td>
<td>No extended cyclic prefix</td>
</tr>
<tr>
<td>PHICH Duration</td>
<td>Normal</td>
<td>1 symbol only, no extended PHICH</td>
</tr>
<tr>
<td>PDCCH length</td>
<td>2 symbols</td>
<td>Refer to 3GPP TS 36.521-1,C.1</td>
</tr>
<tr>
<td>DCI Aggregation Level</td>
<td>8 CCEs</td>
<td>Refer to 3GPP TS 36.521-1,C.3.1</td>
</tr>
<tr>
<td></td>
<td>Note that there is no UL in this test so DCI 0 is not relevant</td>
<td></td>
</tr>
<tr>
<td>Qrxlevmin</td>
<td>-120 dBm</td>
<td>Lower than the expected RSRP to ensure that the UE camps on the target cell</td>
</tr>
</tbody>
</table>
### Parameter | Recommended Value | Comment
--- | --- | ---
\(Q_{\text{qualmin}} \) | -20 Db | Lower than the expected RSRQ to ensure that the UE camps on the target cell.
\(S_{\text{IntraSearchP}} \) | 0 dB | I.e. UE may choose not to perform intra-frequency measurements. Note: In Rel-8 only \(S_{\text{IntraSearch}} \) is sent. In case Rel-8 is used this shall have the same value as \(S_{\text{IntraSearchP}} \) in the table.
\(S_{\text{IntraSearchQ}} \) | 0 dB | 
\(\text{Paging and System Information change notification on PDCCH} \) | No | No P-RNTI on PDCCH
\(\text{System Information Reception} \) | No | System information will be transmitted, but not received by the UE during the test.
\(\text{OCNG} \) | According to Table E-UTRA_FDD_Idle_1 | According to Table E-UTRA_TDD_Idle_1 | 3GPP TS 36.521, A.5.1.2

Smartphones perform differently under good and poor network conditions. It is suggested to test the devices under different network conditions and then compare the performance with other devices. The strong/normal/weak signal environment configuration is given as below. Testers may set up the strong/normal/weak network configuration for the network related test cases.

### Parameter | Recommended Value | Comment
--- | --- | ---
\(\text{Weak signal environment} \) | 3.2 | Communication function response performance
\(\text{Normal signal environment} \) | 3.2.1 | The "Contacts" start up speed
\(\text{Strong signal environment} \) | Description

\(\text{SINR} \) | -3~0dB | 5~10dB | 15~20dB
\(\text{RSRP} \) | -120~110dBm | -100~90dBm | -90~80dBm
To measure the average time taken between user activation of the “Contacts” APP and the address book reaching an active state until the contact list interface is presented completely.

**Reason for test**

The time taken for the “Contacts” APP to start has an impact on a user experience. A shorter start-up time is a better result than a longer start-up time. This test case evaluates the overall “Contacts” APP start-up time to ensure users do not have to wait long for the “Contacts” APP to start.

**Initial condition**

The initial configuration is the same as defined in section 2.1.2. In addition, 800 contacts are already stored in the “Contacts”.

**Test Procedure**

1. The user interface of the DUT is opened.
2. Set the high speed camera to capture the operation process.
3. Touch the “Contacts” icon or launch button.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching the Contacts icon or launch button to when the contact list interface is displayed completely.
5. Close the “Contacts” APP in the Smartphone background.
6. Repeat the test steps 2 through to 5 ten times to obtain an average “Contacts” start-up time.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

**3.2.2 The contact search speed**

**Description**

Enter the contact name in the search bar of the contact list. Measure the time difference between finishing entering the characters and displaying of the related contact.

**Reason for test**

To ensure users do not have to wait long when searching for contacts.

**Initial condition**

The initial configuration is the same as defined in section 2.1.2. In addition, 800 contacts are already stored in the “Contacts”. 10 specified contacts are defined among these 800 contacts. They were provided in section 3.1.1 in the contact source examples.

**Test Procedure**

1. The user interface of the DUT is opened.
2. Set the high speed camera to capture the operation process.
3. Open the contact list interface with the contact search bar.
4. Use copy-paste function to paste one of the specified names e.g. “aejpz” directly into the address bar.
5. Playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing pasting the name until the related contact is completely displayed.
6. Close the “Contacts” APP in the Smartphone background.
7. Repeat the test steps 2 through to 6 to search the other nine specified names and obtain an average contact search speed.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

Additional Notes

In order to check the terminal search ability, the search range is suggested to cover the whole alphabet and the 10 contact names e.g. “aejpz” “bmkfw” “cwhay” “dbxioa” are specified since the letters cover the whole alphabet range from a-z.

3.2.3 The Contacts list scrolling fluency

Description

Measure the fluency (frame rate) when user scroll up/down the contacts list.

Reason for test

To ensure the Smartphone provides the user with a smooth scroll up/down performance. In theory, the Smartphone screen refreshes 60 fps uniformly and the frame interval variance will be zero. If the scroll process is not fluent or blocked, the screen refresh rate will be less than the theoretical value and the refresh frame interval variance will be greater than zero.

Initial condition

The initial configuration is the same as defined in section 2.1.2. In addition, 800 contacts are already stored in the “Contacts”. They were provided in section 3.1.1 in contact source examples.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Open the contact list interface.
3. Set a high speed camera to capture the scroll procedure.
4. Slide up /down the contact list on the Smartphone screen with an input device.
5. Calculate the average frame rate (“a” fps) according to the captured contacts list scroll procedure.

Frame rate (“a” fps) measurement recommendation:
• Playback the high speed camera captured test process frame by frame (Frame Rate of camera is assumed to be “Y” fps).
• View the video to find the point when the input device starts sliding the contact list on screen and record the frame number as $F_1$. Find the point when the display finishes scrolling and record the frame number as $F_2$.
• Calculate the duration of scroll as:
$$t = \frac{(F_2 - F_1)}{Y} \text{ seconds}$$
• The screens refresh process: The captured video shows one clear image when the screen starts to refresh. A few blurred images will be shown until the screen has refreshed. The next clear image appears on the captured video when the screen starts to refresh. Within this interval “t”, pick out the frames that show the screen has refreshed. Count the number of refresh frames (assumed to be A).
• The average actual frame rate during scrolling can be calculated by the equation:
$$\text{Actual Frame Rate } a = \frac{A}{t}.$$ 

6. Calculate the frame interval variance $(\delta^2)$ according to the captured contact list scroll procedure video.

Frame interval variance $(\delta^2)$ measurement recommendation:

• Playback the high speed camera captured test process frame by frame.
• Watch the video to pick out the refreshing frames. Calculate the time interval $(\Delta T_1, \Delta T_2, \Delta T_3 \ldots)$ between these refreshing frames.
• If the theory frame rate is 60, then the theory average frame interval $(\Delta T)$ is 14.3ms, which can be considered as the variance centre.
• The frame interval variance during scrolling can be explained by the Equation:
$$\delta^2 = \sum (\Delta T - \Delta T_{(1,2,3 \ldots)})^2$$

7. Repeat the test steps 1 to 6 ten times and obtain an average contact list scroll performance.

Expected Result

The times required are decided by individuals, however for the frame rate, higher is better; for the frame interval variance, lower is better.

Additional Notes

Define a standard scroll speed to reduce the impact from the user. The metronome could provide testers with a standard speed - 60 bpm is recommended as a scroll speed for fingers. Another approach is to use an automated mechanism to operate the Smartphone.

The following is an example recommended for the input device moving range:

Start point for scrolling up: Bottom of the contact list area, end point: Top of the contact list area. The user should not release the input device from the screen. If the user releases the screen, touch events will cease sending and the “scroll animator” may coast. This will change the frame rate. It is recommended to use an automated mechanism to operate the Smartphone. The procedure for scrolling down is vice-versa.
3.2.4 "Phone Call" start up speed

Description

To measure the average time taken between user activation of the "Phone call" APP and the "Phone call" APP reaching an active state: the keypad interface is presented completely.

Reason for test

The time taken for the "Phone Call" APP to start has an impact on user experience: A shorter start-up time is a better result than a longer start-up time. This test case evaluates the overall "Phone Call" APP start-up time to ensure users do not have to wait long for "Phone Call" to be initiated.

Initial condition

The initial configuration is the same as defined in section 2.1.2. In addition, 800 contacts are already stored. They were provided in section 3.1.1 source examples. 20 calls are dialled and the call history shall display these 20 calls.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Use the high speed camera to capture the operation process.
3. Touch the "Phone Call" icon or launch button.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching
the “Phone Call” icon or launch button to when the keypad interface is displayed completely.
5. Close the “Phone Call” APP in the Smartphone background.
6. Repeat the test step 2 – 5 for ten times to obtain an average “Phone Call” start-up time.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

3.2.5 “Messages” start up speed

Description

Measure the average time taken between user activation of the “Message” APP and the “Message” APP reaching an active state - the message list is presented completely.

Reason for test

The test case evaluates the "Message" response time to ensure users do not have to wait long.

Initial condition

The initial configuration is the same as defined in section 2.1.2. In addition, 1000 short messages are already stored in the “Messages” APP. The messages examples are specified in section 3.1.1 source examples.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Use the high speed camera to capture the operation process.
3. Touch the “Messages” icon or launch button.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching the “Messages” icon or launch button to when the message list is displayed completely.
5. Close the “Messages” APP in the Smartphone background.
6. Repeat the test steps 2 to 5 ten times to obtain an average “Message” start-up time.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

3.2.6 Message search speed

Description

Measure the time needed to search one contact within all of the short messages.

Reason for test
The test case evaluates the "Messages" response time to ensure users do not have to wait long when searching for one particular message.

**Initial condition**

The initial configuration is the same as defined in section 2.1.2. In addition, 1000 short messages are already stored in the “Messages” APP. The messages examples are specified in section 3.1.1 source examples.

**Test Procedure**

1. The user interface of the Smartphone is opened.
2. Set the high speed camera to capture the operation process.
3. Open the message list interface including the message search bar.
4. Enter one character, like “B” in the search bar.
5. Playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing entering the characters to when the related contact is completely displayed.
6. Close the “Messages” APP in the Smartphone background.
7. Repeat the test steps 2 to 6 nine more times to search the other nine characters and obtain an average message search speed.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

**Additional Notes**

In order to check the terminal search ability, the search range is suggested to cover the whole alphabet.

3.2.7 "Email" start up speed

**Description**

To measure the average time taken between user activation of the “Email” APP and reaching an active state until the mail list is presented completely.

**Reason for test**

The test case evaluates the “Email” response time to ensure users do not have to wait long.

**Initial condition**

The initial configuration is the same as defined in the section 2.1.2. In addition, 60 mails are already stored in the “Email-Inbox”. The mails are specified in section 3.1.1 source examples.

**Test Procedure**

1. The user interface of the Smartphone is opened.
2. Use the high speed camera to capture the operation process.
3. Touch the “Email” icon or launch button.
4. Use the computer player to playback the testing process captured by the high speed
   camera and analyse frame by frame. Record the time it takes from finishing touching
   the “Email” icon or launch button to until when the mail list finished updating
   completely.
5. Close the “Email” APP in the Smartphone background.
6. Repeat the test steps 2 to 5 ten times to get an average “Email” start-up time.

Expected Result
The times required are decided by individuals, however the shorter the time the better the
user experience.

Additional Notes
Please note that no emails should be sent to the test email account, that way the email
starting speed won’t be affected by the email loading speed.

3.2.8 Email loading speed
Description
To measure the time difference between starting loading one email and displaying of the
entire email.

Reason for test
To ensure users do not have to wait too long when loading one email.

Initial condition
- The initial configuration is the same as defined in the section 2.1.2. In addition, 60
  emails are already stored in the “Email-Inbox”.
- One unread new email with one 3MB picture has been sent to the email account. The
  email with the attachment is specified in section 3.1.1 source examples.
- When sending the “new” email, the attached photo size should be configured to be
  the actual size not the reduced size.

Test Procedure
1. Use the high speed camera to capture the process.
2. Press the “Email” icon or launch button to start up the testing email APP.
3. Send one new email to the testing email account by another device or computer. One
   picture is attached in this email and the size of the picture is 3MB.
4. Update and check for new emails. Select the unread new email to load the entire
   email.
5. Playback the testing process captured by the high speed camera and analyse frame
   by frame. Record the time it takes from finishing pressing the new email to when the
   whole email including the picture has completed loading.
6. Close the email application in the Smartphone background.
7. Repeat the test steps 2 to 6 ten times, with a short break of five seconds, to obtain an
   average email loading time.
Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

Additional Notes

The content of the email should be specified and standardised to ensure the test result is repeatable and comparable for different terminals.

3.3 Local multimedia function response performance

3.3.1 The “Camera” start-up speed

Description

To measure the average time taken between user activation of the “Camera” APP and the camera reaching an active state until the photo taking interface is presented completely.

Reason for test

The time taken for the “Camera” APP to start has an impact on user experience: A shorter start-up time is a better result than a longer start-up time. This test case evaluates the overall “Camera” APP start-up time to ensure users do not have to wait long for the “Camera” APP to start.

Initial condition

The initial configuration is the same as defined in section 2.1.2. In addition, 200 photos are already stored in the “Photos”. The photos are specified in section 3.1.1 source examples.

Test Procedure

1. The user interface of the Smartphone is opened.
2. Set the high speed camera to capture the operation process.
3. Touch the “Camera” icon or launch button.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching the Camera icon or launch button to until when the photo taking interface with a clear viewfinder is displayed completely.
5. Close the “Camera” APP in the Smartphone background.
6. Repeat the test steps 2 to 5 ten times to obtain an average “Camera” start-up time.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

3.3.2 The "Photo" APP (Gallery) start-up speed

Description
To measure the average time taken between user activation of the “Photos” APP and the “Photos” reaching an active state until the album is presented completely.

**Reason for test**

The time taken for the “Photo” APP to start has an impact on user experience: A shorter start-up time is a better result than a longer start-up time. This test case evaluates the overall “Photos” APP start-up time to ensure users do not have to wait long to view the photo album.

**Initial condition**

The initial configuration is the same as defined in section 2.1.2. In addition, 200 photos are already stored in the “Photos”. The photos are specified in section 3.1.1 source examples.

**Test Procedure**

1. The user interface of the Smartphone is opened.
2. Set the high speed camera to capture the operation process.
3. Touch the “Photos” icon or launch button.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching the “Photos” icon or launch button to until when the album is displayed completely.
5. Close the “Photos” APP in the Smartphone background.
6. Repeat the test steps 2 to 5 ten times to obtain an average “Photos” start-up time.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

**3.3.3 Picture loading speed**

**Description**

To measure the time difference between starting to load one picture and displaying the entire image. The size of the picture is 2Mb or above.

**Reason for test**

To ensure users do not have to wait too long when downloading one photo.

**Initial condition**

The initial configuration is the same as defined in section 2.1.2. In addition, 200 photos are already stored in the “Photos”. The photos are specified in section 3.1.1 source examples.

**Test Procedure**

1. Set the high speed camera to capture the operation process.
2. Touch the “Photos” icon or launch button to show the album list.
3. Select one picture.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching the picture to until when the whole picture is displayed completely.

5. Close the “Photos” APP in the Smartphone background.

6. Repeat the test steps 2 to 5 ten times to obtain an average picture loading time.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

### 3.3.4 Picture sliding performance

**Description**

Measure the sliding fluency (frame rate) when the user slides the screen to switch photos.

**Reason for test**

To ensure the Smartphone provides the user with a smooth photo sliding performance. In theory, the Smartphone screen refreshes 60 fps uniformly and the frame interval variance will be zero. If the sliding process is not fluent or blocked, the screen refresh rate will be less than the theoretical value and the refresh frame interval variance will be greater than zero.

**Initial condition**

The initial configuration is the same as defined in section 2.1.2. In addition, 200 pictures are already stored in the “Photos”. The photos are specified in section 3.1.1 source examples.

**Test Procedure**

1. The user interface of the Smartphone is opened.
2. Open the “Photos” album.
3. Set a high speed camera to capture the sliding procedure.
4. Slide the picture on the Smartphone screen from right to the left with an input device.
5. Calculate the average frame rate (“a” fps) according to the captured picture sliding procedure.

**Frame rate (“a” fps) measurement recommendation:**

- Playback the high speed camera captured test process frame by frame (Frame Rate of camera is assumed to be “Y” fps).
- View the video to find the point when the input device starts sliding one picture on screen and record the frame number as $F_1$. Find the point when the display finishes sliding and record the frame number as $F_2$.
- Calculate the duration of sliding as:
  \[ t = \frac{(F_2 - F_1)}{Y} \text{ seconds} \]
- The screen refreshes process: The captured video shows one clear image when the screen starts to refresh. A few blurred images will be shown until the screen has refreshed. The next clear image appears on the captured video when the screen starts to refresh. Within this interval “t”, pick out the frames that show the screen has refreshed. Count the number of refresh frames (assumed to be A).
The average actual frame rate during sliding can be calculated by the equation:

\[
\text{Actual Frame Rate } a = \frac{A}{t}.
\]

6. Calculate the frame interval variance \((\delta^2)\) according to the captured picture sliding procedure video.

Frame interval variance \((\delta^2)\) measurement recommendation:

- Playback the high speed camera captured test process frame by frame.
- Watch the video to pick out the refreshing frames. Calculate the time interval \((\Delta T_1, \Delta T_2, \Delta T_3, \ldots)\) between the refreshing frames.
- If the theory frame rate is 60, then the theory average frame interval \((\Delta T)\) is 14.3ms, which can be considered as the variance centre.
- The frame interval variance during sliding can be explained by the equation:

\[
\delta^2 = \sum (\Delta T - \Delta T_{1,2,3,\ldots})^2
\]

7. Repeat the test steps 4 - 6 ten times and obtain an average picture slide performance.

**Expected Result**

The times required are decided by individuals, however for the frame rate, higher is better. For the frame interval variance, lower is better.

**Additional Notes**

Define a standard slide speed to reduce the impact from the user. The metronome could provide testers with a standard speed - 60 bpm is recommended as a slide speed for fingers. Another approach is to use an automated mechanism to operate the Smartphone.

The following is an example recommendation for the input device moving range:

Start point for sliding: 25% screen length to the left side of screen, end point: 25% screen length to the right side of screen. The user should not release the input device from the screen. If the user releases the screen, touch events will cease sending and the "scroll animator" may coast. This will change the frame rate. It is recommended to use an automated mechanism to operate the Smartphone.

![Figure 12 Screen slide illustration](image)
3.3.5 Photograph taking speed

Description

To measure the average time used to take one photo: from touching the photo shooting key to when the photo preview is presented completely.

Reason for test

To ensure users do not have to wait too long when taking one photo.

Initial condition

- The initial configuration is the same as defined in section 2.1.2. In addition, 200 pictures are already stored in the “Photos”. The photos are specified in section 3.1.1 source examples.
- There are many factors that may influence the photo shooting speed e.g. the image quality, background light, background colour. It is necessary to define a standard scenario for the photo taking background.
- The camera settings are given as below:

<table>
<thead>
<tr>
<th>Smartphone Camera settings</th>
<th>Statues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pixels</td>
<td>The original pixel of the Photo sensor</td>
</tr>
<tr>
<td>The format of photo</td>
<td>JPEG</td>
</tr>
<tr>
<td>The photo effects or special edition</td>
<td>OFF</td>
</tr>
<tr>
<td>Photo colour</td>
<td>Factory default setting</td>
</tr>
<tr>
<td>Flash light</td>
<td>OFF</td>
</tr>
<tr>
<td>White Balance</td>
<td>Auto</td>
</tr>
<tr>
<td>ISO Sensitivity</td>
<td>Auto</td>
</tr>
<tr>
<td>Autofocus</td>
<td>ON</td>
</tr>
<tr>
<td>Camera with time delay</td>
<td>OFF</td>
</tr>
</tbody>
</table>

- The environment light source condition is the same as defined in section 2.1: The light in the test lab should make the captured image clear enough to be analysed on the computer. Avoid strong or flickering light. Additionally, some light temper is suggested here:

<table>
<thead>
<tr>
<th>Light type</th>
<th>Light temper</th>
</tr>
</thead>
<tbody>
<tr>
<td>D65</td>
<td>6500K</td>
</tr>
<tr>
<td>D50</td>
<td>5000K</td>
</tr>
<tr>
<td>TL84</td>
<td>4000K</td>
</tr>
<tr>
<td>A light</td>
<td>2856K</td>
</tr>
</tbody>
</table>

- The picture that will be shot is the standard colour test chart. E.g. X-rite Colour Checker Chart with 24 colours.
Test Procedure

1. Set the high speed camera to capture the operation process.
2. Touch the “Camera” icon and enter the photo taking interface.
3. Click the photo taking icon/button.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching the photo taking button to when the whole photo preview is displayed completely.
5. Close the “Camera” APP in the Smartphone background.
6. Repeat the test steps 2 to 5 ten times to obtain an average photo taking time.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

Additional Notes

In this test case the complete display of photo preview means the image becomes stable and not blurry.

3.3.6 Video shooting /photograph switching speed

Description

To measure the time used to switch from the camera mode to video shooting mode or video mode to camera mode.

Reason for test

To ensure users do not have to wait long when switching between camera and video shooting mode.

Initial condition

The initial configuration is the same as defined in section 2.1.2. In addition, 200 pictures are already stored in the “Photos”. The photos are specified in section 3.1.1 source examples.

Test Procedure

1. Set the high speed camera to capture the operation process.
2. Touch the “Camera” icon and enter the photo taking interface.
3. Click the camera/video mode switch icon.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching the camera/video mode switch icon to when the video shooting interface is displayed completely.
5. Apply the same method to record the video mode to camera mode switch speed.
6. Close the “Camera” APP in the Smartphone background.
7. Repeat the test steps 2 to 6 ten times to obtain an average video/camera mode switching speed.

Expected Result
The times required are decided by individuals, however the shorter the time the better the user experience.

**Additional Notes**

In this test case, the complete display of photo preview means the image becomes stable and not blurry.

### 3.3.7 Local audio loading speed

**Description**

Playback an audio file stored on the phones internal memory and measures the latency to hear the audio or when the pause key appears.

**Reason for test**

To evaluate the local multimedia applications response time and ensure users do not have to wait long when loading one audio.

**Initial condition**

The initial configuration is the same as defined in the section 2.1.2. In addition, 50 audios are already stored in the “Music” or “Recording”-APP. The audios are specified in section 3.1.1 source examples.

**Test Procedure**

1. Set the high speed camera to capture the operation process.
2. Touch the “Music” or “Recording” icon and enter the audio playlist interface.
3. Select one audio file and play it.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching the audio play key to when the audio starts to play (the pause key appears).
5. Close the “Music” or “Recording” APP in the Smartphone background.
6. Repeat the test steps 2 to 5 ten times to obtain an average audio loading speed.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

### 3.3.8 Local video loading speed

**Description**

Playbacks a video file stored on the phones internal memory and measures the time to show the first frame of the video.

**Reason for test**

To evaluate the local multimedia applications response time and ensure users do not have to wait long when loading one video.
Initial condition

The initial configuration is the same as defined in section 2.1.2. In addition, 30 video files are already stored in the “video file” APP.

Test Procedure

1. Set the high speed camera to capture the operation process.
2. Touch the “video file” icon and enter the video playlist interface.
3. Select one video file and play it.
4. Use the computer player to playback the testing process captured by the high speed camera and analyse frame by frame. Record the time it takes from finishing touching the video play icon to when the video starts to play (the pause key appears).
5. Close the “video file” APP in the Smartphone background.
6. Repeat the test steps 2 to 5 ten times to obtain an average video loading speed.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

3.4 Network registration response performance

3.4.1 LBS service locating speed

Description

Measure the speed that the "Location based Service" APP needs to provide the user with the accurate location. (The location based service APP is the Smartphone’s original APP as supplied with the devices when sold).

Reason for test

To ensure the Smartphone provides the user with a quick and accurate location service.

Initial condition

The initial configuration is the same as defined in section 2.1.2. The AGPS function on the Smartphone is switched on.

Test Procedure

1. Set the high speed camera to capture the operation process.
2. Open the location service APP in place A then switch on the airplane mode.
3. Go to another place B. The horizontal distance between A and B is at least 20 meters.
4. Switch off the airplane mode, open the location service APP at place B and get the current location again.
5. Use the computer player to playback the testing process captured by high speed camera and analyse frame by frame. Record the time it takes from finishing touching the current location icon at place B to when the accurate location is shown on the map.
6. Close the “map APP” in the Smartphone background.
7. Repeat the test steps 2 to 6 ten times to obtain an average LBS service locating speed.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

3.4.2 System power on speed

Description

To measure the system power-on speed.

Reason for test

To ensure the Smartphone provides the user with a quick network registration.

Initial condition

The initial configuration is the same as defined in section 2.1.2.

Test Procedure

1. Set the high speed camera to capture the operation process.
2. The Smartphone is in shut down state. Long press the power on/off button.
3. Use the computer player to playback the testing process captured by high speed camera and analyse frame by frame. Record the time point as T1 when the screen starts to become bright. Record the time point as T2 when the network signal appears.
4. Obtain the system power on speed by calculating the time difference between T1 and T2.
5. Power off the Smartphone.
6. Repeat the test steps 2 to 5 ten times to obtain an average power on speed.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

3.4.3 Airplane mode switching speed

Description

Measure the time used to switch from airplane mode to idle mode.

Reason for test

To ensure the Smartphone provides the user with a quick network registration.

Initial condition

The initial configuration is the same as defined in section 2.1.2.
Test Procedure

1. Set the high speed camera to capture the operation process.
2. Set the Smartphone status into airplane mode status, with a short break of ten seconds. Turn off the airplane mode icon and change the Smartphone state into idle status.
3. Use the computer player to playback the testing process captured by high speed camera and analyse frame by frame. Record the time point as T1 when the airplane mode icon is turned off. Record the time point as T2 when the network signal appears in idle status.
4. Obtain the airplane mode switching speed by calculating the time difference between T1 and T2.
5. Repeat the test steps 2 to 4 ten times to obtain the average airplane mode switching speed.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

3.5 Screen response performance

3.5.1 Home screen sliding speed in horizontal direction

Description

Slide on the screen in horizontal direction. Measure the time difference from the moment when the user finishes the screen sliding gesture to the moment when the home screen starts sliding.

Reason for test

To ensure the Smartphone provides users with a quick and smooth sliding performance.

Initial condition

The initial configuration is the same as defined in section 2.1.2. In order to slide the home screen leftwards or rightwards, there are at least 2 home pages on the screen and each home screen has one leftmost APP icon and one rightmost APP icon.

Test Procedure

1. Set the high speed camera to capture the operation process.
2. Slide on the home screen from left to right in horizontal direction.
3. Choose the leftmost APP icon as reference. Playback the testing process captured by the high speed camera and analyse frame by frame. Record the time point as T1 when the finger starts to slide the home screen. Record the time point as T2 when the reference APP icon starts to move to the right.
4. Obtain the sliding speed of home screen from left to right by calculating the time difference between T1 and T2.
5. Apply the same method to obtain the sliding speed of home screen from right to left.
6. Repeat the test steps 2 to 5 ten times and obtain the average home screen sliding speed in horizontal direction.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

**Additional Notes**

![Figure 13 Screen slide illustration](image)

### 3.5.2 Screen sliding speed in vertical direction

**Description**

Slide on the Smartphone screen in vertical direction. Measure the time difference from the moment when the user finishes the screen sliding gesture to the moment when the screen starts sliding.

**Reason for test**

To ensure the Smartphone provides user with a quick and smooth sliding performance.

**Initial condition**

The initial configuration is the same as defined in section 2.1.2. In order to slide the screen upwards or downwards, there are at least 2 pages on the contact list screen.

**Test Procedure**

1. Open the contact list. Set the high speed camera to capture the operation process.
2. Slide on the contact list from the bottom of the contact list to the top of the contact list. The finger moving range is given in the additional notes.
3. Choose the bottom contact as reference. Playback the testing process captured by the high speed camera and analyse frame by frame. Record the time point as T1 when the finger starts to slide the contact list upwards. Record the time point as T2 when the reference contact starts to move upwards.
4. Obtain the screen sliding speed from bottom to top by calculating the time difference between T1 and T2.
5. Apply the same method to obtain the screen sliding speed from top to bottom.
6. Repeat the test steps 2 to 5 ten times and obtain the average screen sliding speed in vertical direction.

**Expected Result**

The times required are decided by individuals, however the shorter the time the better the user experience.

**Additional Notes**

Starting point for sliding upwards: Bottom of the contact list area. End point: Top of the contact list area. The user should not release the input device from the screen. If the user releases the screen, touch events will cease sending and the "scroll animator" may coast. This will change the frame rate. It is recommended to use an automated mechanism to operate the Smartphone. The procedure for sliding downwards is vice-versa.

**Figure 14 Sliding upwards illustration**

**Figure 15 Sliding downwards illustration**

### 3.5.3 Home screen slide fluency

**Description**

Slide on the home screen. Measure the fluency (frame rate and frame interval variance) when the home screen starts sliding.

**Reason for test**

To ensure the Smartphone provides user with a quick and smooth sliding performance.

**Initial condition**
The initial configuration is the same as defined in section 2.1.2. In order to slide the home screen leftwards or rightwards, there are at least 2 home pages on the screen.

**Test Procedure**

1. The home screen of the Smartphone is opened. Set a high speed camera to capture the sliding procedure.
2. Slide from left to right on the Smartphone home screen page with the input device.
3. Calculate the average frame rate ("a" fps) according to the captured sliding procedure.

**Frame rate ("a" fps) measurement recommendation:**

- Playback the high speed camera captured test process frame by frame (Frame Rate of camera is assumed to be "Y" fps).
- View the video to find the point when the input device starts sliding the home screen and record the frame number as \( F_1 \). Find the point when the display finishes sliding and record the frame number as \( F_2 \).
- Calculate the duration of sliding as:
  \[ t = \frac{(F_2 - F_1)}{Y} \text{ seconds} \]
- The screens refresh process: The captured video shows one clear image when the screen starts to refresh. A few blurred images will be shown until the screen has refreshed. The next clear image appears on the captured video when the screen starts to refresh. Within this interval "t", pick out the frames that show the screen has refreshed. Count the number of refresh frames (assumed to be \( A \)).
- The average actual frame rate during sliding can be calculated by the equation:
  \[ \text{Actual Frame Rate} \ a=\frac{A}{t}. \]
4. Calculate the frame interval variance (\( \delta^2 \)) according to the captured sliding procedure video.

**Frame interval variance (\( \delta^2 \)) measurement recommendation:**

- Playback the high speed camera captured test process frame by frame.
- Watch the video to pick out the refreshing frames. Calculate the time interval (\( \Delta T_1, \Delta T_2, \Delta T_3, \ldots \)) between these refreshing frames.
- If the theory frame rate is 60, then the theory average frame interval (\( \Delta T \)) is 14.3ms, which can be considered as the variance centre.
- The frame interval variance during home screen sliding can be explained by the equation:
  \[ \delta^2 = \sum (\Delta T - \Delta T_{1,2,3,\ldots})^2 \]
5. Apply the same method to obtain the sliding fluency when the home screen is slide from right to left.
6. Repeat the test step 2 –5 for ten times and obtain an average home page sliding fluency.

**Expected Result**

The times required are decided by individuals, however for the frame rate, higher is better; for the frame interval variance, lower is better.
Additional Notes

Define a standard sliding speed to reduce the impact from the user. The metronome could provide testers with a standard speed - 60 bpm is recommended as a scroll speed for fingers. Another approach is to use an automated mechanism to operate the Smartphone.

The recommendation for the sliding range: From 25% screen length left to right as shown in figure 13.

3.5.4 Drag and drop latency

Description

Long press an application icon on the left side of the home screen. Drag and drop icon from left to right. Record the delay until when the image shadow of the icon appears.

Reason for test

To ensure the Smartphone provides user with a quick and smooth dragging performance

Initial condition

The initial configuration is the same as defined in section 2.1.2.

Test Procedure

1. Set the high speed camera to capture the operation process.
2. Long press an application icon on the left side of the home screen. Drag and drop icon from far left to far right.
3. Playback the testing process captured by the high speed camera and analyse frame by frame. Record the time point as T1 when the finger starts to drag the icon from left to right. Record the time point as T2 when the icon starts to move.
4. Obtain the drag and drop latency by calculating the time difference between T1 and T2.
5. Apply the same method to obtain the drag and drop latency when the APP icon is dragged from far right to far left on the screen.
6. Repeat the test steps 2 to 5 ten times and obtain an average drag and drop latency.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

3.5.5 Drag and drop fluency

Description

Test the system overall response fluency (measure the frame rate or Frame interval variance), when the user drag and drop one APP icon on the screen.

Reason for test

To ensure the Smartphone provides user with a quick and smooth dragging performance
Initial condition

The initial configuration is same as defined in the section 2.1.2.

Test Procedure

1. Set a high speed camera to capture the drag and drop procedure.
2. Long press an application icon on the left side of the home screen. Drag and drop the icon from left to right.
3. Calculate the average frame rate ("a" fps) according to the captured procedure.

Frame rate ("a" fps) measurement recommendation:

- Playback the high speed camera captured test process frame by frame (Frame Rate of camera is assumed to be “Y” fps).
- View the video to find the point when the input device or finger starts dragging the APP icon and record the frame number as $F_1$. Find the point when the image of the icon starts moving and record the frame number as $F_2$.
- Calculate the duration of drag and drop as:
  \[ t = \frac{(F_2-F_1)}{Y} \text{ seconds} \]
- The screen refreshes process: The captured video shows one clear image when the screen starts to refresh. A few blurred images will be shown until the screen has refreshed. The next clear image appears on the captured video is when the screen starts to refresh. Within this interval “t”, pick out the frames that show the screen has refreshed. Count the number of refresh frames (assumed to be A).
- The average actual frame rate during drag and drop can be calculated by the equation: Actual Frame Rate $a = \frac{A}{t}$.
4. Calculate the frame interval variance $(\delta^2)$ according to the captured drag and drop procedure video.

Frame interval variance $(\delta^2)$ measurement recommendation:

- Playback the high speed camera captured test process frame by frame.
- Watch the video to pick out the refreshing frames. Calculate the time interval $(\Delta T_1, \Delta T_2, \Delta T_3 ...)$ between these refreshing frames.
- If the theory frame rate is 60, then the theory average frame interval $(\Delta T)$ is 14.3ms, which can be considered as the variance centre.
- The frame interval variance during drag and drop can be explained by the equation:
  \[ \delta^2 = \sum (\Delta T - \Delta T_{1,2,3,..})^2 \]
5. Apply the same method to obtain the drag and drop fluency when the APP icon is dragged from right to left on the screen.
6. Repeat the test step 2 – 5 for ten times and obtain an average screen drag and drop fluency.

Expected Result

The times required are decided by individuals, however for the frame rate, higher is better; for the frame interval variance, lower is better.
3.5.6 Screen rotation speed

Description

Test the screen rotation response speed when the screen is switched from a horizontal position to a vertical position.

Reason for test

To ensure the Smartphone provides the user with a smooth rotational performance.

Initial condition

The initial configuration is the same as defined in section 2.1.2.

Test Procedure

1. Open one photo from the gallery.
2. Set a high speed camera to capture the rotation procedure.
3. Rotate the terminal from a vertical to horizontal orientation in clockwise direction. The photo on the screen becomes stable indicating the photo has finished its rotation.
4. Playback the testing process captured by a high speed camera and analyse frame by frame. Record the time point as T1 when the device completes position switch. Record the time point as T2 when the photo finishes rotation.
5. Obtain the screen rotation speed by calculating the time difference between T1 and T2.
6. Apply the same method to obtain the rotation speed when the home screen is rotated from horizontal to vertical orientation in clockwise direction.
7. Apply the same method for the test steps 3 to 6 again when the terminal is rotated in anticlockwise direction.
8. Repeat the test steps 3 to 7 ten times to obtain an average screen rotation speed.

Expected Result

The times required are decided by individuals, however the shorter the time the better the user experience.

Additional Notes

The illustrations for terminal vertical/horizontal rotation in clockwise direction are shown in figures 16 and 17. The anticlockwise rotation is vice-versa. Define a standard device rotation speed to reduce the impact from the user. The metronome could provide testers with a standard speed. 90 bpm is suggested as a recommendation for device rotation speed. Another approach is to use an automated mechanism to operate the Smartphone.
3.5.7 Screen unlock speed

Description

Test the time used to unlock the screen after user finishes the unlock gesture.

Reason for test

To ensure the user do not have to wait long when unlocking the Smartphone screen.

Initial condition

The initial configuration is the same as defined in section 2.1.2. The Smartphone has set the screen unlock password or fingerprint or graphic unlock already.

Test Procedure

1. Set a high speed camera to capture the unlock procedure.
2. Unlock the screen. The different mechanisms could be input password or fingerprint verification or graphic unlock.
3. Playback the testing process captured by a high speed camera and analyse frame by frame. Record the time point as T1 when the unlock mechanism is completed. Record the time point as T2 when the homepage is displayed completely.
4. Obtain the screen unlock speed by calculating the time difference between T1 and T2.
5. Repeat the test steps 2 to 4 ten times to obtain an average screen unlock speed.

Expected Result
The times required are decided by individuals, however the shorter the time the better the user experience.

### 3.5.8 Screen Click sensitivity

**Description**
Test whether the touch screen is too sensitive and causes false touch action.

**Reason for test**
To ensure the Smartphone screen provide user with an accurate click response.

**Initial condition**
The initial configuration is the same as defined in section 2.1.2. The screen is set to be unlocked.

**Test Procedure**

1. Open the keypad of the phone.
2. Place one capacitive finger above keypad on the screen. The distance between the capacitive finger and the screen is about 1mm and the capacitive finger cannot touch the screen.
3. Confirm the number buttons won’t be tapped and screen won’t react.
4. Repeat the test steps 1 to 3 ten times.

**Expected Result**
The number buttons won’t be tapped and screen won’t react when the capacitive finger is placed about 1mm away from the keypad on the screen.

### 4 System Stability Testing

#### 4.1 Test Environment and configuration

**4.1.1 Test Scenarios**
If devices operate for extended period without shutdown, the Device memory will increase and cause system defects or slow running. So the system stability test is to operate the Device for a long period of time to evaluate the stability performance.

The following test topics 1-11 will be executed repeatedly for 5*8 hours. Record the total number of defects. The defects will be divided into different levels: critical, major, normal, and minor.

**Test topics scope:**
1. Phone call stability test
2. Message stability test
3. Mail stability test
4. RCS stability test
5. Browser stability test
6. APP downloads and uninstall stability test
7. Personal information management stability test
8. Multimedia function stability test
9. Multi-task stability test
10. Menu stability test
11. Wi-Fi connection stability test

4.1.2 Device Configuration:
- The initial configuration is the same as defined in section 2.1.2.
- Switch on the Device one week before starting the test and configure everything. The device stays switched on during the whole testing (5*24 hours).
- Device will be connected to a power supply.
- The DUT has already stored compiled Emails, SMS, MMS, audio files and 100 contacts. These standard contacts, Email, audio files sources could take reference to section 3.1.1.
- The android phone APP is available here: https://github.com/GSAMATerminals/Smartphone-Performance-Test-Case-Guideline-Public

4.1.3 Test environment preparation:
It is suggested to use a signal simulator to provide a repeatable test environment. The GSM/GPRS/WCDMA/LTE network configuration refers to the GSMA TS.09 BLM document chapter 3.

4.1.4 Defects definition
1. Reboot: Phone shuts down and restarts automatically.
2. Freeze: Screen stops working without any response.
3. Automatic shutdown: Phone shuts down automatically.
4. Slow running: The phone responses slowly when carrying out any operation.
5. Network connection defects: When the network signal condition is good, the phone shows no service or phone calls cannot be received and dialled. The defects cannot be automatically restored within limited hours only when the Device is restarted manually.
6. APP/APK not responding: There is no response when opening, running, or closing an APP.
7. Error box appearance: Pop-up error box when opening, running, or shutting down the APP.
8. APP exits automatically: The APP exits automatically when it is opened or running.
9. APP functional failures: Functional failure happens when running the APP.
10. Interface error: Some error displayed on the interface of screen.
11. Other defects.

The defects level:

<table>
<thead>
<tr>
<th>Critical/Major defects</th>
<th>Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reboot</td>
<td>Error box appearance</td>
</tr>
<tr>
<td>Automatic shutdown</td>
<td>APP exits automatically</td>
</tr>
</tbody>
</table>
4.2 Phone call stability test:

4.2.1 MO/MT voice call service when the Device is registered in 2G network

**Description**

Dial voice calls from the address book and from the recent contacts list respectively. Answer voice calls.

**Initial condition**

- The initial configuration is the same as defined in section 4.1.2.
- The DUT is registered in 2G network.

**Test Procedure**

1. Open the contact list of DUT.
2. Choose one contact and make a voice call.
3. Keep on line for 5 seconds
4. End the call.
5. Repeat step 1, 2, 3, 4 and redial for 30 times.
6. Open the recent contacts list.
7. Choose one recent call record and make a voice call.
8. Keep on line for 5 seconds.
9. End the call.
10. Repeat step 6, 7, 8, 9 and redial for 30 times.
11. Reference1 makes a voice call to DUT.
12. DUT answers the voice call.
13. Keep on line for 5 seconds.
14. End the voice call.
15. Repeat step 11, 12, 13, 14 and redial for 30 times.

**Expected Result**

1. For step 2, 7 and 12 the call can be connected.
2. For step 3, 8 and 13 the call can be maintained.
3. For step 4, 9 and 14 the call can be ended.
4. For step 5, 10 and 15 the loop can be processed successfully.

4.2.2 MO/MT voice call service when the Device is registered in 3G network

Repeat the test case 4.2.1 when the DUT is registered in 3G network.
4.2.3 MO/MT voice call service when the Device is registered in 4G network
Repeat the test case 4.2.1 when the DUT is registered in 4G networks and the VoLTE function of DUT is turned off.

4.2.4 MO/MT VoLTE voice call service
Description
Dial a VoLTE voice call from the address book and from the recent contacts list respectively.
Answer VoLTE calls.

Initial condition
- The initial configuration is the same as defined in section 4.1.2.
- The DUT is registered in 4G network.
- The VoLTE function of DUT is turned on.

Test Procedure
1. Open the contact list of DUT.
2. Choose one contact and make a VoLTE voice call.
3. Keep on line for 5 seconds
4. End the call.
5. Repeat step 1, 2, 3, 4 and redial for 30 times.
6. Open the recent contacts list.
7. Choose one recent call record and make a VoLTE voice call.
8. Keep on line for 5 seconds.
9. End the call.
10. Repeat step 6, 7, 8, 9 and redial for 30 times.
11. Reference 1 makes a voice call to DUT.
12. DUT answers the voice call.
13. Keep on line for 5 seconds.
14. End the voice call.
15. Repeat step 11, 12, 13, 14 and redial for 30 times.

Expected Result
1. For step 2, 7 and 12 the call can be connected.
2. For step 3, 8 and 13 the call can be maintained.
3. For step 4, 9 and 14 the call can be ended.
4. For step 5, 10 and 15 the loop can be processed successfully.

4.2.5 MO/MT VoLTE video call service
Description
Dial and answer VoLTE video calls.

Initial condition
- The initial configuration is the same as defined in section 4.1.2.
- The DUT is registered in 4G network.
- The VoLTE function is turned on.

**Test Procedure**

1. Open the contact list of DUT.
2. Choose one contact and make a VoLTE video call.
3. Keep on line for 5 seconds after the video call has been established.
4. End the video call.
5. Repeat step 1, 2, 3, 4 and redial for 10 times.
6. Reference 1 makes a VoLTE video call to DUT.
7. DUT answers the video call.
8. Keep on line for 5 seconds after the video call has been established.
9. End the video call.
10. Repeat step 6, 7, 8, & 9 and redial for 10 times.

**Expected Result**

1. For step 2 and 7 the video call can be connected.
2. For step 3 and 8 the video call can be maintained.
3. For step 4 and 9 the video call can be ended.
4. For step 5 and 10 the loop can be processed successfully.

**4.3 Message stability test**

**4.3.1 Send text messages (SMS)**

**Description**

DUT sends text messages.

**Initial condition**

- The initial configuration is the same as defined in section 4.1.2.
- The network is set to the highest available RAT technology (4G>3G>2G).
- One contact number has been stored in the phone contact list.
- One text message has been stored in the message box, which contains numbers, symbols and characters. The SMS shall be between 10 and 20 word long.

**Test Procedure**

1. Enter the message box.
2. Copy the stored text message and enter SMS forward interface.
3. Add a receiver from the phone contact list.
4. Forward SMS to the receiver contact.
5. Wait for ten seconds.
6. Repeat step 1, 2, 3, 4 & 5 for 30 times.

**Expected Result**

1. For step 3, the contact can be added as receiver successfully.
2. For step 4, the message can be forwarded successfully.
3. For step 5, the receiver can receive the message with correct content.
4.3.2   Receive text message (SMS)

Description
DUT receives text messages.

Initial condition
- The initial configuration is the same as defined in section 4.1.2.
- The network is set to the highest available RAT technology (4G>3G>2G).
- The content of the received text message contains numbers, symbols and characters. The SMS shall be between 10 and 20 word long.

Test Procedure
1. The DUT is in idle mode.
2. Reference 1 sends messages to DUT.
3. Wait for ten seconds.
4. Repeat step 1, 2 and 3 for 30 times.

Expected Result
1. For step 3 & 4, the DUT can receive the message and the content is displayed correctly.

4.3.3   Send multimedia messages (MMS)

Description
DUT sends multimedia messages.

Initial condition
- The initial configuration is the same as defined in section 4.1.2.
- The network is set to the highest available RAT technology (4G>3G>2G).
- One contact number has been stored in the phone contact list.
- One multimedia message has been stored in the message box of DUT, the size is 300kb or the maximum size that the DUT can support.

Test Procedure
1. Enter the message box.
2. Copy the stored multimedia message and enter MMS forward interface.
3. Add a receiver from the phone contact list.
4. Forward MMS to the receiver.
5. Wait for ten seconds.
6. Repeat step 1, 2, 3, 4 & 5 for 10 times.

Expected Result
1. For step 3, the contact can be added as receiver successfully.
2. For step 4, the message can be forwarded successfully.
3. For step 5, the receiver can receive the message with correct content.
4.3.4 Receive multimedia message (MMS)

Description

DUT receives multimedia messages.

Initial condition

- The initial configuration is the same as defined in section 4.1.2.
- The network is set to the highest available RAT technology (4G>3G>2G).
- The size of the received multimedia message is 300kb or the maximum size that the DUT can support.

Test Procedure

1. The DUT is in idle mode.
2. Reference 1 sends multimedia messages to DUT.
3. Wait for ten seconds.
4. Repeat step 1, 2 & 3 for 10 times.

Expected Result

1. For step 3 & 4, the DUT can receive the message and the content is displayed correctly.

4.4 E-Mail stability test

4.4.1 E-mail service when the device is registered in 3G network

Description

DUT sends and receives e-mails without attachment when the network registration is in 3G.

Initial condition

- The initial configuration is the same as defined in section 4.1.2.
- The DUT is registered in 3G network.
- Each of DUT and Reference 1 has one email without attachment stored in the email inbox. The mails are specified in section 3.1.1 source examples.

Test Procedure

1. Enter the inbox of DUT.
2. Select the stored email and enter the mail forwarding interface.
3. Edit recipient address and forward the email.
4. Wait for ten seconds.
5. Repeat step 1, 2 & 3 for 30 times.
6. The DUT is in idle mode.
7. Reference 1 sends the stored e-mail to DUT.
8. Wait for ten seconds.
9. Repeat step 7 & 8 for 30 times.

Expected Result

1. For step 3, the email can be forwarded successfully.
2. For step 4, the receiver can receive the email with correct content.
3. For step 8, the DUT can receive the email with correct content.

4.4.2 E-mail service when the device is registered in 4G network
Repeat the test case 4.4.1 when the DUT is registered in 4G network.

4.4.3 E-mail service with attachment added

Description
DUT sends and receives e-mails with attachment when the network registration is set to the highest available RAT technology.

Initial condition
- The initial configuration is the same as defined in section 4.1.2.
- The network is set to the highest available RAT technology (4G>3G>2G).
- Each of DUT and Reference 1 has one email with attachment stored in the inbox. The mails are specified in section 3.1.1 source examples.
- For the attachment use a file of size 1Mb.

Test Procedure
1. Enter the inbox of DUT.
2. Select the stored email and enter the mail forwarding interface.
3. Edit recipient address and forward the email.
4. Wait for ten seconds.
5. Repeat step 1, 2 & 3 for 30 times.
6. The DUT is in idle mode.
7. Reference 1 sends the stored e-mail to DUT.
8. Wait for ten seconds.
9. Repeat step 7 & 8 for 30 times.

Expected Result
1. For step 3, the email can be forwarded successfully.
2. For step 4, the receiver can receive the email with correct attachment.
3. For step 8, the DUT can receive the email with correct attachment.

4.5 RCS stability test

4.5.1 Sending and Receiving RCS messages in 3G network

Description
DUT sends and receives RCS messages when the network registration is in 3G.

Initial condition
- The initial configuration is the same as defined in section 4.1.2.
- The DUT is registered in 3G network.
- DUT, Reference 1 and 2 are registered RCS users.
Test Procedure

1. DUT sends a RCS message in a 1-to-1 chat to Reference 1.
2. Reference 1 sends a RCS message in a 1-to-1 chat to DUT.
3. DUT sends a RCS message in a Group chat to Reference 1 and 2.
4. Reference 1 sends a RCS message in a Group chat to DUT and Reference 2.
5. Wait for ten seconds.
6. Repeat step 1, 2, 3 & 4 for 30 times.

Expected Result

1. For step 1, the RCS message is send successfully.
2. For step 2, the RCS message is received successfully.
3. For step 3, the RCS message is send successfully.
4. For step 4, the RCS message is received successfully.

4.5.2 Sending and Receiving RCS messages in 4G network
Repeat the test case 4.5.1 when the DUT is registered in 4G network.

4.5.3 Receive Simultaneous RCS File Transfer

Description
DUT receives simultaneous RCS file transfers.

Initial condition

- The initial configuration is the same as defined in section 4.1.2.
- The DUT is set to the highest available RAT technology (4G>3G>2G).
- DUT and Reference 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 are registered RCS users and RCS File Transfer enabled.
- DUT is in ten 1-to-1 chats, each with one Reference device.

Test Procedure

1. Reference 1 – 10 sends DUT a file with RCS file transfer in a 1-to-1 chat timely as close as possible.
2. DUT accepts all file transfers as fast as possible.
3. Wait for all file transfers to complete.
4. Repeat step 1, 2 & 3 for 5 times.

Expected Result

1. For step 2, all files are received.

4.6 Browser stability test

4.6.1 Open the browser homepage when the network registration is in 3G mode

Description
Open the homepage of the browser when the network registration is in 3G mode.

**Initial condition**

- The initial configuration is the same as defined in section 4.1.2.
- The network is set to be 3G mode.
- The homepage of the browser is already defined and should not be the Google Homepage or some kind of locally stored start-page.

**Test Procedure**

1. Open the browser of DUT.
2. Open the defined homepage of the browser.
3. Wait for ten seconds, access another page, clear the cache and then close the browser.
4. Repeat step 1, 2 & 3 for 30 times.

**Expected Result**

1. For step 1, the browser can be started up successfully.
2. For step 2, the homepage can be opened.
3. For step 4, the loop can be processed successfully.

4.6.2 Open the browser homepage when the network registration is in 4G mode

Repeat the test case 4.6.1 when the DUT is registered in 4G network.

4.6.3 Open multiple pages simultaneously on the browser

**Description**

Open multiple pages simultaneously on the browser when the network registration is in set to the highest available RAT technology.

**Initial condition**

- The initial configuration is the same as defined in section 4.1.2.
- The network is set to the highest available RAT technology (4G>3G>2G).
- Bookmarks for ten different webpages are already stored in the browser.

**Test Procedure**

1. Open the browser of DUT.
2. Access the ten different bookmarks, each in a single parallel window in the browser.
3. Wait for ten seconds, close all but one window and access another page, clear the cache and then close the browser.
4. Repeat step 1, 2 & 3 for 30 times.

**Expected Result**

1. For step 1, the browser can be started up successfully.
2. For step 2, the webpages can be opened.
3. For step 4, the loop can be processed successfully.

4.7 APP/APK install and uninstall stability test

4.7.1 Install and operate and remove one APP/APK

Description

Install one APP/APK from platform and then uninstall it.

Initial condition

- The initial configuration is the same as defined in section 4.1.2.
- The network of DUT is set to be the highest available RAT technology (4G>3G>2G).
- Tester can choose the top famous APP/APKs in market based on local user habit.

Besides, one test script was developed and uploaded on GitHub website. The test script can automatically execute specific APK installation, operation and uninstall in loop. The instructions for the test scripts are in the Annex B of this document. Tester could also self-define the APKs to be tested and the number of automatic test cycles. Test script modifications are also welcomed.

https://github.com/GSAMATerminals/Smartphone-Performance-Test-Case-Guideline-Public

Test Procedure

1. Open the APP/APK download platform.
2. Download the APP/APK and DUT install it automatically.
3. When the APP/APK finishes installing then wait for 10 seconds.
4. Open the APP/APK.
5. Operate the APP/APK.
6. Exit the APP/APK then wait for 10 seconds.
7. Uninstall and remove the APP/APK that was downloaded.
8. Repeat step 1 to 7 for 10 times.

Expected Result

1. For step 2, the APP/APK can be downloaded and installed successfully.
2. For step 4, the APP/APK can be opened successfully.
3. For step 5, the APP/APK can be operated successfully.
4. For step 6, the APP/APK can be exited successfully.
5. For step 7, the APP/APK can be removed successfully.

4.8 Personal information management stability test

4.8.1 Add and cancel the alarm

Description

Add and cancel the alarm.

Initial condition

- The initial configuration is the same as defined in section 4.1.2.
- The network of DUT is set to be the highest available RAT technology (4G>3G>2G).

**Test Procedure**

1. Open the alarm of DUT.
2. Set one alarm that sounds 1 minute later.
3. Wait until the alarm sounds.
4. Stop the alarm and cancel the alarm.
5. Exit the alarm.
6. Repeat step 1, 2, 3 & 4 for 30 times.

**Expected Result**

1. For step 2, the alarm can be set successfully.
2. For step 3, the alarm sounds.
3. For step 4, the alarm can be cancelled successfully.

### 4.8.2 Add, edit and delete a phone contact.

**Description**

Add, edit and delete the phone contact.

**Initial condition**

- The initial configuration is the same as defined in section 4.1.2.
- The network of DUT is set to be the highest available RAT technology (4G>3G>2G).

**Test Procedure**

1. Add one contact with phone numbers, email and address and save the newly added contact.
2. Exit the contacts list user interface.
3. Re-enter the contact list interface, edit the contact mobile number and save the newly edited contact.
4. Exit the contacts list user interface.
5. Re-enter the contact list and delete the added contact.
6. Repeat step 1, 2, 3, 4 & 5 for 30 times.

**Expected Result**

1. For step 1, the contact can be added successfully.
2. For step 3, the contact can be edited successfully.
3. For step 5, the contact can be deleted successfully.

### 4.9 Multimedia function stability test

#### 4.9.1 Take and delete photos with front facing camera

**Description**

Take and delete photos with front facing camera.

**Initial condition**
The initial configuration is the same as defined in section 4.1.2.
The network of DUT is set to be the highest available RAT technology (4G>3G>2G).

**Test Procedure**

1. Open the front facing camera interface.
2. Take one photo.
3. Enter the gallery and delete the photo.
4. Repeat step 1, 2 & 3 for 30 times.

**Expected Result**

1. For step 2, the photo can be taken successfully.
2. For step 3, the photo can be deleted successfully.

### 4.9.2 Take and delete multiple photos with front facing camera

**Description**

Take and delete multiple photos with front facing camera.

**Initial condition**

- The initial configuration is the same as defined in section 4.1.2.
- The network of DUT is set to be the highest available RAT technology (4G>3G>2G).

**Test Procedure**

1. Open the front facing camera interface.
2. Take one hundred photos in quick succession.
3. Enter the gallery and delete all the photos.
4. Repeat step 1, 2 & 3 for 5 times.

**Expected Result**

1. For step 2, the photos can be taken successfully.
2. For step 3, the photos can be deleted successfully.

### 4.9.3 Record, play and delete local videos with front facing camera

**Description**

Record, play and delete local videos with front facing camera interface.

**Initial condition**

- The initial configuration is the same as defined in section 4.1.2.
- The network of DUT is set to be the highest available RAT technology (4G>3G>2G).

**Test Procedure**

1. Open the front facing camera interface and switch to video shooting mode.
2. Record one video for 30 seconds and save the video.
3. Play the recorded video for 10 seconds.
4. Enter the gallery and delete the recorded video.
5. Repeat step 1, 2, 3 & 4 for 30 times.

**Expected Result**

1. For step 2, the video can be taken successfully.
2. For step 3, the video can be played successfully.
3. For step 4, the photo can be deleted successfully.

### 4.9.4 Take and delete photos with rear facing camera

Repeat the test case 4.9.1 with rear facing camera.

### 4.9.5 Take and delete multiple photos with rear facing camera

Repeat the test case 4.9.2 with rear facing camera.

### 4.9.6 Record, play and delete local videos with rear facing camera

Repeat the test case 4.9.3 with rear facing camera.

### 4.9.7 Play sound files by using the default music player

**Description**

Play sound files by using the default music player.

**Initial condition**

- The configuration is the same as defined in section 4.1.2.
- The network of DUT is set to be the highest available RAT technology (4G>3G>2G).
- Five sound files have already been stored in the DUT. The audio files sources are referenced in section 3.1.1.

**Test Procedure**

1. Open the music player of the DUT.
2. Choose and play the stored sound files for 10 seconds.
3. Play the next four sound files for 10 second.
4. Repeat step 1, 2, 3 for 30 times.

**Expected Result**

1. For step 2 & 3, the sound files can be played successfully.

### 4.10 Menu stability test

#### 4.10.1 Settings menu stability test

**Description**

DUT opens the menus in settings.

**Initial condition**
The configuration is the same as defined in section 4.1.2.
• The network of DUT is set to be the highest available RAT technology (4G>3G>2G).

Test Procedure

1. DUT opens the interface of settings.
2. Open the main functions in settings: cellular network selection, Wi-Fi, Bluetooth, personal hotspot, sounds, wallpaper, display, general, account and security setting.
3. Close “Settings” menu.
4. Repeat step 1, 2 & 3 for 30 times.

Expected Result

1. For step 1, the interface of settings can be opened successfully.
2. For step 2, the UI interface of each settings menu can be presented correctly.

4.10.2 Phone call menu stability test

Description

DUT opens the menus of phone call.

Initial condition

• The configuration is the same as defined in section 4.1.2.
• The network of DUT is set to be the highest available RAT technology (4G>3G>2G).
• Ten recent calls are stored in the call history.

Test Procedure

1. DUT opens the UI interface of phone call.
2. Open the menus of phone call respectively: call history, missed calls, contacts, and keypad.
3. Exit the phone call interface and repeat step 1, 2 for 30 times.

Expected Result

1. For step 1, the phone call interface can be opened successfully.
2. For step 2, the UI interface of each phone call menu can be presented correctly.

4.10.3 Messages (SMS) menu stability test

Description

DUT opens the menus of message.

Initial condition

• The configuration is the same as defined in section 4.1.2.
• The network of DUT is set to be the highest available RAT technology (4G>3G>2G).
• Ten messages are stored already.

Test Procedure
1. DUT opens the UI interface of message.
2. Open the menus of message respectively: unread message, message list, add new message and delete message.
3. Exit the message interface and repeat step 1, 2 for 30 times.

**Expected Result**

1. For step 1, the message interface can be opened successfully.
2. For step 2, the UI interface of each message menu can be presented correctly.

### 4.10.4 Email menu stability test

**Description**

DUT opens the menus of mail.

**Initial condition**

- The configuration is the same as defined in section 4.1.2.
- The network of DUT is set to be the highest available RAT technology (4G>3G>2G).
- Ten e-mails are stored already.

**Test Procedure**

1. DUT opens the UI interface of email box.
2. Open the menus of email respectively: drafts, trash, inbox and outbox.
3. Exit the email interface and repeat step 1 & 2 for 30 times.

**Expected Result**

1. For step 1, the email interface can be opened successfully.
2. For step 2, the UI interface of each email menu can be presented correctly.

### 4.11 Wi-Fi connection stability test

#### 4.11.1 Wi-Fi service start up stability test

**Description**

DUT turns on and turns off the Wi-Fi service.

**Initial condition**

- The configuration is the same as defined in section 4.1.2.
- The DUT has been connected to the Wi-Fi access point.
- Wi-Fi service of DUT is shutdown.

**Test Procedure**

1. Turn on the Wi-Fi service of DUT and wait for 10 seconds.
2. Close the Wi-Fi access point network and wait for 10 seconds.
3. Turn off the Wi-Fi service of DUT.
4. Repeat step 1, 2 & 3 for 30 times.

**Expected Result**
1. For step 1, the Wi-Fi of DUT can be started successfully and connected automatically.
2. For step 2, the Wi-Fi of DUT is disconnected.
3. For step 3, the Wi-Fi service is turned off.

4.11.2 Open one website when the Wi-Fi connection is active

**Description**

Open one website when the Wi-Fi connection is active.

**Initial condition**

- The configuration is the same as defined in section 4.1.2.
- The DUT has been connected to the Wi-Fi access point.
- Wi-Fi service of DUT is turned off.

**Test Procedure**

1. Turn on the Wi-Fi service of DUT.
2. When the Wi-Fi of DUT is connected, open the home webpage in the browser.
3. Open another Web page and clear the cache.
4. Exit the browser and turn off the Wi-Fi
5. Repeat step 1 to 4 for 30 times.

**Expected Result**

1. For step 1, the Wi-Fi of DUT can be connected.
2. For step 2, webpage can be loaded.
3. For step 4, the Wi-Fi can be closed.

5  Smartphone Camera Image Quality Test

5.1 Test environment and configuration

5.1.1 Overview

This section will test the Smartphones photographic capability and performance, based on different use cases. The evaluation will be carried out looking at different key features which the device supports.

5.1.2 The test environment preparation:

The tests are taken in different scenarios for example: photographing a portrait at night, photograph the sun rise scene, photograph indoor objects. Here we give the general suggestions and photo examples for different scenarios. There are no restrictions on the place or the period that the photos should be taken.

- **The device configuration:** The Focus distance, Aperture, ISO sensitivity, exposure compensation, white balance values are set to default values when device is sold.
- The screen auto-brightness feature is turned on.
- Use the default camera: the photo format is set to JPG, the image size is set to maximum, the compression and colour modes are set to “default”.
- Automatic photometry (autofocus, automatic white balance, automatic exposure)

### 5.1.3 Test result evaluation:

The picture quality will be judged by looking at the following elements: Exposure, Contrast, Focus, Colour rendering and Noise distortion. Each element will be rated between 1 and 3 depending on its quality. One being the lowest score.

<table>
<thead>
<tr>
<th>Scores</th>
<th>Exposure Control</th>
<th>Tone Control</th>
<th>Colour Restoration</th>
<th>Imaging Analysis</th>
<th>Noise containment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Poor</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Some photo examples and score evaluations are given in the link below:

https://github.com/GSMATerminals/Smartphone-Performance-Test-Case-Guideline-Public

### 5.2 City scenery at dusk

**Description**

Use the rear camera to take a photo of a large scene with sky and ground lights. The street and house lighting should be on but the sky should be in twilight. Ideally just after sunset with little to no cloud (like the example above).

<table>
<thead>
<tr>
<th>Device A</th>
<th>General display</th>
<th>Detailed display</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Device B</th>
<th>General display</th>
<th>Detailed display</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
</tr>
</tbody>
</table>

**Test Procedure**
1. Use the rear camera to take a photo of a large scene with sky and ground lights. The flash is turned off. If the camera has the built-in “night view” and “long exposure mode”, these can be selected.

2. Take 5 photos continuously.

3. Use the computer screen to play back the photos in the test lab.

4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.

5. View the photo under detail view and evaluate the imaging clarity, resolution and image noise containment.

6. Repeat step 4 & 5 for the 5 photos and record the average score.

**Expected Result**

1. Exposure control: The exposure is accurate and close to the brightness distribution of the real scene; some optimization enhancement can be made by the DUT.

2. Tone control: For the bright areas, the image should show the details and level of the night scene. For the dark areas, the image should show less deep darkness as little as possible. Even for the night scenes, the whole image should maintain a clear tone and be in line with people’s expectations for the night scenes view.

3. Colour restoration: The colour of the screen can be optimized without colour distortion. The cold tone of the sky and the warm tone of the ground should be in line with people’s aesthetic expectation for the night scene. The colours of the lights are displayed correctly. Certain colour rendering can be optimized to make the lights in line with people’s aesthetic expectation.

4. Image analysis: The focus area of the image should be clear enough, and the depth of field should be large enough. The image detail should be real and delicate, no excessive sharpening, no obvious digital pixel compression and processing trace. For detailed display evaluation, the lights in the image should be clearly displayed without too much extra shine. The shining logos or Banners/Letters should be displayed clearly without too much blurring.

5. Noise containment: The light sensitivity is generally high. For the bright area the noise distortion should be as little as possible. For the transition area the noise distortion should be as little as possible. The image should keep the original details of the night scenes while containing the noise.

6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

**5.3 Sun rise**

**Description**

Use the rear camera to take a photo of a sunrise scene and place the sun in a non-central part. The photograph time is morning when sun rises.
Test Procedure

1. Use the rear camera to take a photo of sunrise scene and place the sun in a non-central part. The flash is turned off. If the camera has the built-in “sunrise nature” mode, this can be selected.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the imaging clarity, resolution and image noise containment.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

Expected Result

1. Exposure control: The exposure is accurate and close to the brightness distribution of the real scene.
2. Tone control: The sky is not over exposed, the sun/clouds retain the real colour levels. The ground is not completely dark. The image can clearly display the details.
and edges of the buildings. The overall contrast of light and shade is clear and suitable.

3. Colour restoration: The whole picture needs to present an early morning tone atmosphere, which is in line with people’s aesthetic expectation for the early morning scenery.

4. Image analysis: The focused area of the image should be clear enough, and the depth of field should be large enough. The image detail should be real and delicate, no excessive sharpening, no obvious digital pixel compression and processing trace.

5. Noise containment: There is no noise distortion in the real scene content, so any noise distortion generated in the image is bad. The image should contain the noise distortion and also maintain the original details, layers of authenticity.

6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

5.4 Sun set

Use the rear camera to take a photo of the sun set and place the sun in a non-central part. The photograph time is dawn when sun sets.

<table>
<thead>
<tr>
<th></th>
<th>General display</th>
<th>Detailed display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device A</td>
<td><img src="image" alt="Device A" /></td>
<td><img src="image" alt="Device A" /></td>
</tr>
<tr>
<td>Device B</td>
<td><img src="image" alt="Device B" /></td>
<td><img src="image" alt="Device B" /></td>
</tr>
</tbody>
</table>

Test Procedure
1. Use the rear camera to take a photo of the sunset and place the sun in a non-central part. The flash is turned off. If the camera has the built-in "sunset mode", this can be selected.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the imaging clarity, resolution and image noise containment.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

**Expected Result**

1. Exposure control: The exposure is accurate and close to the brightness distribution of the real scene; some optimization enhancement can be made by the DUT.
2. Tone control: For the bright areas, the image should show the details of the dawn scene. For the dark areas, the image should show less deep darkness at best as little as possible. The whole image should maintain a clear tone and be in line with people's expectations for the sunset scenes view.
3. Colour restoration: The colour of the image can be optimized without colour distortion and should be in line with people's aesthetics and expectation for the sunset scene.
4. Image analysis: The focus area of the image should be clear enough, and the depth of field should be large enough. The image detail should be real and delicate, no excessive sharpening, no obvious digital pixel compression and processing trace.
5. Noise containment: There should be no noise distortion in the bright region. For the transition area the noise distortion should be as small as possible. The image should keep the original details of the sunset scenes while containing the noise distortion.
6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

### 5.5 Object at a micro distance

**Description**

Use the rear camera to take a photo with the object occupying the main position of the picture. The photograph environment is indoor or outdoor with sufficient lighting.
Test Procedure

1. Use the rear camera to take a photo with the object occupying the main position of the picture. Flash is turned off.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the imaging clarity, resolution and image noise containment.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

Expected Result

1. Exposure control: The exposure of the object should be accurate and close to the brightness distribution of the real scene.
2. Tone control: There is no complete darkness or white on the image. The tone level of the object is rich and real. The transition from bright area to dark area should be natural.
3. Colour restoration: The colour of the image needs to represent the original colour of the object. Some enhancement can be made to highlight the image colour.
4. Image analysis: The focused area of the image should be clear enough. The image detail should be real and delicate, no excessive sharpening, no obvious digital pixel compression and processing trace.

5. Noise containment: The noise distortion of the object is almost invisible. For the area that’s out of focus and for the transition area, the noise distortion should be as small as possible. The image should keep the original details of the object while containing the noise distortion.

6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

5.6 Portrait with backlight for rear camera

Description

The photograph direction is backlight. Use the rear camera to take a photo of a person from the waist up as portrait.

<table>
<thead>
<tr>
<th></th>
<th>General display</th>
<th>Detailed display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device A</td>
<td><img src="image1" alt="Device A General Display" /></td>
<td><img src="image2" alt="Device A Detailed Display" /></td>
</tr>
<tr>
<td>Device B</td>
<td><img src="image3" alt="Device B General Display" /></td>
<td><img src="image4" alt="Device B Detailed Display" /></td>
</tr>
</tbody>
</table>

Test Procedure
1. Use the rear camera to take a photo of a person from the waist up as portrait. If the camera has the built-in portrait at backlight exposure mode, this can be selected. The flash mode is automatic.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the portrait exposure, tone and skin colour control.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

**Expected Result**

1. Exposure control: The exposure of portrait should be accurate and close to the brightness distribution of the real scene. The background sky can show certain details without serious exposure.
2. Tone control: The image should show the details and level of the portrait. The background scene of the image should show less deep darkness and less white.
3. Colour restoration: Certain optimization can be made on the portrait skin and the background colour. The tone of the image should be in line with the aesthetic expectation for the portrait at backlight scene.
4. Image analysis: The portrait face should be clearly focused. The scene could have some certain blur effect outside of the focused area. The image details should be real and delicate with moderate sharpening. No obvious digital pixel compression and processing trace.
5. Noise containment: The portrait skin is smooth with less noise distortion. For the transition area, the noise distortion should be as small as possible. For the area that’s out of focus, the noise containment should keep the original details and levels of the scene.
6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

**5.7 Portrait at night**

**Description**

The photograph is taken at night or in a dark area with lights on. Use the rear camera to take a photo of a person from the waist up as portrait. Set the portrait face as the focused area.

| General display | Detailed display |
Test Procedure

1. Use the rear camera to take a photo of a person from the waist up as portrait. If the camera has the built-in “portrait at night” mode, this can be selected. Flash mode is automatic and no extra light.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the portrait exposure, tone and skin colour control.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

Expected Result

1. Exposure control: The exposure of portrait should be accurate. The background light is not over exposed. The luminance of the flash light is sufficient and the brightness distribution of the whole image is uniform.
2. Tone control: The image should show the details and level of the portrait. The dark area of the image should show less deep darkness. The overall contract between bright area and dark area should be moderate.
3. Colour restoration: The portrait skin doesn’t show the colour deviation because of the flash light.
4. Image analysis: The portrait face should be clearly focused. The scene could have some certain blur effect outside of the focused area. The image details should be real
and delicate with moderated sharpening. No obvious digital pixel compression and processing trace.

5. Noise containment: The light sensitivity is generally high. The portrait skin is smooth with less noise distortion. For the transition area, the noise distortion should be as small as possible. For the area that’s out of focus, the noise containment should keep the original details and levels of the scene.

6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

5.8 Portrait at daylight

Description

The photograph is taken outdoor in day time. Use the rear camera to take a photo of a person from the waist up as portrait. Avoid intense sunshine expose on face. Set the portrait face as the focused area. Flash mode is turned off.

<table>
<thead>
<tr>
<th>General display</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device A</td>
</tr>
<tr>
<td><img src="image" alt="Portrait at daylight" /></td>
</tr>
</tbody>
</table>
Test Procedure

1. Use the rear camera to take a photo of a person from the waist up as portrait. If the camera has the built-in “portrait” mode, this can be selected.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the portrait exposure, tone and skin colour control.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

Expected Result

1. Exposure control: The exposure of the portrait should be accurate.
2. Tone control: The background scene of the image should show less deep darkness and less white.
3. Colour restoration: It is better to have some colour rendering for the background. For detailed display, Portrait beauty can be made to optimize the skin colour and lip colour.
4. Image analysis: The portrait face should be clearly focused. The scene could have some certain blur effect outside of the focused area. It is acceptable to have some beauty retouching on portrait face. E.g. skin smooth, wrinkle and spot elimination, pouches and black circles elimination.
5. Noise containment: The portrait skin is smooth with less noise distortion. For the transition area, the noise distortion should be as small as possible. For the area that's out of focus, the noise containment should keep the original details and levels of the scene.
6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.
5.9 City scenery at daylight

Description

The photograph time is in daytime. The photograph environment is the outdoor with enough lighting. Use the rear camera to take a photo of the city scenery.

<table>
<thead>
<tr>
<th>Device A</th>
<th>General display</th>
<th>Detailed display</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image1" alt="General display" /></td>
<td><img src="image2" alt="Detailed display" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Device B</th>
<th>General display</th>
<th>Detailed display</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image3" alt="General display" /></td>
<td><img src="image4" alt="Detailed display" /></td>
</tr>
</tbody>
</table>

Test Procedure

1. Use the rear camera to take a photo of the city scenery. The picture should include the sky, ground and one reference object or architecture that can be used for detailed display evaluation.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the imaging clarity, resolution and image noise containment.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

Expected Result

1. Exposure control: The exposure of the scenery should be accurate and close to the brightness distribution of the real scene.
2. Tone control: The sky is not too white and the ground is not too dark. The tone level of the whole image is rich and real. The transition from the bright area to the dark area should be natural.

3. Colour restoration: The colour of the image needs to represent the original colour of the scene. The sky shouldn’t be too white due to over exposure.

4. Image analysis: For detailed display, the referenced object or architecture in the image should be displayed clearly without excessive sharpening.

5. Noise containment: The noise distortion of the sky and the ground architecture is almost invisible. For the area that’s out of focus and for the transition area, the noise distortion should be as small as possible.

6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

### 5.10 Lens zoom

**Description**

The photograph time is in daytime. The photograph environment should be with enough lighting. Use the rear camera to take a photo of an outdoor long-distance scenery with 3 X lens zoom.

<table>
<thead>
<tr>
<th>Device</th>
<th>General display</th>
<th>Detailed display</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><img src="image1.png" alt="General display image" /></td>
<td><img src="image2.png" alt="Detailed display image" /></td>
</tr>
</tbody>
</table>
**Device B**

**Test Procedure**

1. Use the rear camera to take a photo of an outdoor long-distance scenery with 3 X lens zoom. Set one referenced object or architecture as the focused area. The picture should also include the sky, and surroundings that can be used for detailed display evaluation.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the image clarity, resolution and image noise containment.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

**Expected Result**

1. Exposure control: The exposure of the image should be accurate and close to the brightness distribution of the real scene. The sky and light colour object shouldn’t be too white due to over exposure.
2. Tone control: The light colour object is not too white and the deep colour object is not too dark. The tone level of the whole image is rich and real. The transition from bright area to dark area should be natural.
3. Colour restoration: The colour of the image needs to represent the original colour of the scene.
4. Image analysis: For detailed display, the referenced object or architecture details and the surrounding details should be displayed clearly without excessive sharpening.
5. Noise containment: The noise distortion of the sky and the ground architecture is almost invisible.
6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.
5.11 Portrait with flash for rear camera

Description

The photograph is taken in a dark area with a dark coloured background. Use the rear camera to take a portrait photo with flash light turned on.

<table>
<thead>
<tr>
<th>General display</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device A</strong></td>
</tr>
<tr>
<td><img src="image1" alt="Image of Device A" /></td>
</tr>
<tr>
<td><strong>Device B</strong></td>
</tr>
<tr>
<td><img src="image2" alt="Image of Device B" /></td>
</tr>
</tbody>
</table>

Test Procedure

1. Use the rear camera to take a portrait photo. If the camera has the portrait mode, this can be use directly. Set the portrait face as the focused area. Flash mode is turned on.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the portrait exposure, tone and skin colour control.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

**Expected Result**

1. Exposure control: The luminance on the portrait face is sufficient and the brightness distribution of the whole image is uniform.
2. Tone control: The skin of portrait is not too black.
3. Colour restoration: Portrait beauty can be made to optimize the skin colour and lip colour.
4. Image analysis: The portrait face should be clearly focused. The details of the cloth in the scene should be displayed correctly. The scene could have some certain blur effect outside of the focused area.
5. Noise containment: For the portrait skin, the noise distortion should be as small as possible.
6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

5.12 Dynamic mode

**Description**

The photograph time is in daytime with sufficient light. Use the rear camera to take a photo of people while jogging.

<table>
<thead>
<tr>
<th>General display</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device A</strong></td>
</tr>
<tr>
<td><strong>Device B</strong></td>
</tr>
</tbody>
</table>
Test Procedure

1. Use the rear camera to take a photo of people while jogging.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the imaging clarity, resolution and image noise containment.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

Expected Result

1. Exposure control: The exposure of the whole image should be accurate and close to the brightness distribution of the real scene.
2. Tone control: The tone level of the whole image is rich and real.
3. Colour restoration: The colour of the image needs to represent the real colour of the scene. Some enhancement can be made to highlight the image colour.
4. Image analysis: The colour and details of the moving shoes or moving arms should be displayed clearly.
5. Noise containment: To capture dynamic characters, shutter delays are short, so small amount of noise distortion is allowed and should be as small as possible.
6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

5.13 Portrait for background blur effect

Description

The photograph is taken in daylight with background. The distance from the background to the portrait should be 5 meters away. Use the rear camera to photograph a person from the chest up as portrait.

<table>
<thead>
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<th>General display</th>
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<tbody>
<tr>
<td><strong>Device A</strong></td>
</tr>
<tr>
<td><img src="image.jpg" alt="Image" /></td>
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</tbody>
</table>
Test Procedure

1. Use the rear camera to photograph a person from the chest up as portrait. Select the portrait mode or background blur effect mode. Set the portrait face as the focused area.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the portrait exposure, tone and skin colour control.
6. Repeat step 4 & 5 for the 5 photos and record the average score.
7. Repeat steps 1-6 with the rear camera.

Expected Result

1. Exposure control: The exposure and brightness distribution of the whole image should be accurate.
2. Tone control: The image should show the details and tone levels of the portrait and background.
3. Colour restoration: For detailed display, Portrait beauty can be made to optimize the skin colour and lip colour.
4. Image analysis: It is acceptable to have some beauty retouching on portrait face. For detailed display, the blurred background details should be displayed correctly and distributed uniformly. The hair edge should be displayed smoothly.
5. Noise containment: The portrait skin is smooth with less noise distortion.
6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

5.14 Portrait with daylight for front camera

Description
The photograph is taken indoor or outdoor in day time. Avoid intense sunshine expose on the face. Use the front camera to photograph a person from the chest up as portrait.

<table>
<thead>
<tr>
<th>General display</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device A</strong></td>
</tr>
</tbody>
</table>
| ![Image of a person photographed with Device A](image)
| **Device B**    |
| ![Image of a person photographed with Device B](image)

**Test Procedure**

1. Use the front camera to photograph a person from the chest up as portrait. Set the portrait face as the focused area. If the camera has the built-in “portrait” mode, this can be selected.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the portrait exposure, tone and skin
control.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

Expected Result

1. Exposure control: The exposure of portrait and the background scene should be
accurate and close to the brightness distribution of the real scene.
2. Tone control: The image should show the details and tone levels of the portrait. The
transition from bright area to dark area should be natural.
3. Colour restoration: It is better to have some colour rendering for the background. For
detailed display, Portrait beauty can be made to optimize the skin colour and lip
colour.
4. Image analysis: The portrait face should be clearly focused. The scene could have
some certain blur effect outside of the focused area. For detailed display, it is
acceptable to have some beauty retouching on portrait face. E.g. skin smooth, wrinkle
and spot elimination, pouches and black circles elimination.
5. Noise containment: The portrait skin is smooth with less noise distortion. For the
transition area, the noise distortion should be as small as possible. For the area that’s
out of focus, the noise containment should keep the original details and levels of the
scene.
6. According to the requirements of the above five sub-items, each photo is evaluated at
three different levels: excellent, moderate and poor. Give the corresponding scores
for each photo and then obtain the average score.

5.15 Portrait at backlight for front camera

Description

Use the front camera to photograph a person from the chest up as portrait. The flash light is
turned on.
Test Procedure

1. Use the front camera to photograph a person from the chest up as portrait. The photograph is taken outdoor. The photograph direction is into the backlight. If the camera has the built-in portrait at backlight exposure mode, this can be selected.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the portrait exposure, tone and skin colour control.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

**Expected Result**

1. Exposure control: The exposure of portrait should be accurate and close to the brightness distribution of the real scene. The background scene should show certain details without serious exposure.
2. Tone control: The image should show the details and level of the portrait. From the background highlight area to the portrait backlight area, the image should keep the details and tone levels as much as possible.
3. Colour restoration: Certain optimization can be made on the portrait skin and the background colour. The tone of the image should be in line with the aesthetic expectation for the portrait at backlight scene.
4. Image analysis: The portrait face should be clearly focused. The scene could have some certain blur effect outside of the focused area. For detailed display, it is acceptable to have some beauty retouching on portrait face. E.g. skin smooth, wrinkle and spot elimination, pouches and black circles elimination.
5. Noise containment: The portrait skin is smooth with less noise distortion. For the transition area, the noise distortion should be as small as possible. For the area that's out of focus, the noise containment should keep the original details and levels of the scene.
6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.

### 5.16 Portrait with flash for front camera

**Description**

The photograph is taken in a dark area with background lights on. Use the front camera to photograph a person from the chest up as portrait.
**Device A**

**Device B**

### Test Procedure

1. Use the front camera to photograph a person from the chest up as portrait. Set the portrait face as the focused area. Flash mode is turned on and no extra light. If the camera has the built-in portrait mode, this can be selected.
2. Take 5 photos continuously.
3. Use the computer screen to play back the photos in the test lab.
4. View the photo under full size view and evaluate the exposure, tone and colour control of the photo.
5. View the photo under detail view and evaluate the portrait exposure, tone and skin colour control.
6. Repeat step 4 & 5 for the 5 photos and record the average score.

### Expected Result

1. Exposure control: The luminance on portrait face is sufficient and not over exposed. The background light is not over exposed. The light distribution of the whole image is uniform.
2. Tone control: The portrait and the background are not too black. The overall contrast between bright area and dark area should be moderate. The tone and the atmosphere of the whole image should be in line with the expectation of the background.

3. Colour restoration: The portrait skin doesn’t show the colour deviation because of the flash light. Portrait beauty can be made to optimize the skin colour and lip colour.

4. Image analysis: The portrait face should be clearly focused. For detailed display, it is acceptable to have some beauty retouching on portrait face. E.g. skin smooth, wrinkle and spot elimination, pouches and black circles elimination.

5. Noise containment: The light sensitivity is generally high. The portrait skin is smooth with less noise distortion.

6. According to the requirements of the above five sub-items, each photo is evaluated at three different levels: excellent, moderate and poor. Give the corresponding scores for each photo and then obtain the average score.
Annex A  Additional Considerations for browser performance testing

This document provides test cases to support measuring the performance of web browsers and the user experience of web applications. However, it should be noted that there are numerous limitations affecting the measurement that are beyond the control of the tester.

Those limitations include, but are not limited to:

- **Hardware Design Considerations**: the hardware platform always plays a key role in improving the browser performance and related user experience, such as processor, memory, GPU, display, etc. Those are variables leading to reasonable variations in the performance and the user experience. It is necessary to understand and assess those variables so that the measurement of performance and the user experience are comparable.

- **Web Apps Design**: Although a consistent set of webpages and assets are used in the performance and user experience testing, specific design variations such as static vs. responsive page design or combinations of web content (e.g. fixed layout or CSS-driven layout) should be used in designing the tests. Some other factors also affect the performance and measurement, such as:
  - Duplicate Content and Caching Strategy: eliminating duplicate content can effectively improve performance measurement and perceived user experience, thus affect the actual test measurement.
  - Cache Expiration and Cache Control: implementing a full caching mechanism can eliminate unnecessary transactions, reduce the response time and improve the performance and perceived user experience, and thus affect the actual test measurement.
  - Content Pre-fetching: when used properly, pre-fetching the content that the user wants can effectively improve the perceived user experience, and thus affect the actual test measurement.
  - Periodic Transfers and Keep Alive: eliminating unnecessary periodic transfers, and/or using other techniques such as push notifications, HTTP bundling, TCP piggybacking etc. will significantly improve the performance measurement and the user experience, and thus affect the actual test measurement.
  - Multiple, simultaneous TCP connections: opening and closing TCP connection in an efficient way and keeping a persistent TCP connection for multiple usages will improve the performance and perceived user experience, and thus affect the actual test measurement.

- **Network and Server Performance**: Tests should be executed with ample network bandwidth and server capacity, e.g. by default over WLAN and to servers for which server load and stored are not a test factor.

- **OS and Software Platform**: multithreading and background workers will impact the performance of the foreground applications and therefore, the OS and platform resources should be dedicated to the test programs and there should no other threads running in parallel except for the browser and the network attenuator tool.
Annex B  The introduction for the APP/APK automatic test scripts

The test script can automatically execute specific APK installation, operation and uninstall in loop. QQ and wechat are chosen as the APK examples. Tester could also self-define the APKs to be tested and the number of automatic test cycles in the test scripts. Test script modifications are also welcomed. The link: https://github.com/GSMATerminals/Smartphone-Performance-Test-Case-Guideline/Public

1. In order to run the automatic tests, “Appium” and “Eclipse” need to be installed on server.
   - Eclipse: Free IDE. It is an open source development platform based on Java. http://www.eclipse.org
   - Appium: It is an open source test automation tool to drive iOS, Android, and Windows apps runs automatically on the device. https://github.com/appium/appium

2. Run the automatic test script:
   - Start up Appium.
   - Configure server IP address and port, start the Server and connect server to android DUT. (The DUT need to open the debug port)

   - Start up the Eclipse, go to File then Import and select the Existing Maven Projects, which is the developed automatic test script.
Compile and run the Eclipse automatic test script. As an example: The DUT will be controlled by the server to automatically install, open and uninstall two specified APK: QQ and Wechat. Tester could self-define the APKs to be tested and the number of automatic test cycles.
The device will be controlled to carry out the automatic test; on the server we can check the test log:
Annex C  System stability and system response speed test scripts

Automatic test scripts were proposed to help executing some test cases in the system stability testing and system response speed testing.

The link: [https://github.com/GSMATerminals/Smartphone-Performance-Test-Case-Guideline-Public](https://github.com/GSMATerminals/Smartphone-Performance-Test-Case-Guideline-Public)

The “System stability testing” test script can generate an APP that can be installed on android smartphone. The APP can drive the smartphone to automatically start up and exit specified applications and loop execution for 10 times. The APP can also record the times that defects happens during applications start up and exit execution. Email, Browser, Map, Phone are chosen as the application examples. Tester could also self-define the applications to be tested and the number of automatic test loops. The operation guide is in the file “BaseAccessibilityService.java”. The number of loops can be modified in the file “MainActivity.java”.

The “System response testing-single” test script can generate an APP that can be installed on android smartphone. The APP can drive the smartphone to automatically start up and exit specified applications. The applications start up response speed will be recorded. Phone, Message, Camera and Gallery are chosen as the application examples. Tester could also self-define the applications to be executed. The operation guide is in the file “BaseAccessibilityService.java”.

The “System response testing-loop” test script can generate an APP that can be installed on android smartphone. The APP can drive the smartphone to automatically start up and exit specified applications and loop execution for 10 times. The application average starts up response speed will be recorded. Phone, Message, Camera and Gallery are chosen as the application examples. Tester could also self-define the applications to be executed. The operation guide is in the file “BaseAccessibilityService.java”. The number of loops can be modified in the file “MainActivity.java”.

Annex D  Document Management

D.1  Document History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Brief Description of Change</th>
<th>Approval Authority</th>
<th>Editor / Company</th>
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<td>1.0</td>
<td>December 2014</td>
<td>The first version of TS.29 when published, mainly focus on the browser UEX performance test cases.</td>
<td>TSG/PSMC</td>
<td>Xin Wang, China Unicom</td>
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<td>Bin Hu, AT&amp;T</td>
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<td></td>
<td></td>
<td>Stephen McCann, Blackberry</td>
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<td>2.0</td>
<td>August 2016</td>
<td>System Response Performance Test Cases added</td>
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<td>November 2018</td>
<td>Updated with changes approved in TS.29 CR1005 Camera Image Quality Test added</td>
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<td>July 2019</td>
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D.2  Other Information

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<tr>
<td>Editor / Company</td>
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</table>

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Your comments or suggestions & questions are always welcome.