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SERIES Q: SWITCHING AND SIGNALLING, AND ASSOCIATED MEASUREMENTS AND TESTS

Testing specifications – Testing specifications for IMT-2020 and IoT

Testing procedures of augmented reality applications

Recommendation ITU-T Q.4066

International Telecommunication Union

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Recommendation ITU-T Q.4066

Testing procedures of augmented reality applications

Summary

Augmented reality (AR) is a collection of new technologies that perform the function of displaying digital information to a user through special devices (smartphone, AR glasses, projectors, etc.) that allow data to be displayed in visual (3D objects, video, images, etc.), audio or text format alongside real-world objects. Additionally, augmented reality offers the possibility of physical objects and virtual entities, which can cause additional delays in the process of data transformation. Because testing procedures for augmented reality are significantly different from traditional applications, Recommendation ITU-T Q.4066 defines approaches for testing for various applications of AR.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Q.4066	2020-09-29	11	11.1002/1000/14419

Keywords

Augmented reality, QoE, QoS, testing.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had notreceived notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Testing procedures of augmented reality applications

1 Scope

This Recommendation describes the procedure for testing augmented reality (AR) applications. In particular, it contains:

– Classification of AR applications;

– General architecture of the AR application testing model;

– Test specifications for testing various AR applications.

2 References

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

None.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 augmented content [b-ITU-T J.301]: A binary object, such as 2D images, 3D animated models or audio/video streaming files, to be augmented into a predefined augmentation region.

3.1.2 augmented content provider [b-ITU-T J.301]: An entity allowed to develop and provide augmented content.

3.1.3 augmented reality (AR) [b-ITU-T J.301]: A type of mixed reality where graphical elements are integrated into the real world in order to enhance user experience and enrich information.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

2D 2 Dimensions

3D 3 Dimensions

AR Augmented Reality

OS Operating System

PC Personal Computer

QoE Quality of Experience

QoS Quality of Service

5 Conventions

None.

6 Classification of augmented reality applications

Augmented reality (AR) applications represent a group of applications performing a variety tasks set by their developers. In this regard, it is challenging to determine general characteristics for various AR applications, given the wide range of tasks they perform. Consequently, it is crucial to categorize the different AR applications into subgroups in order to identify the common features of these applications.

One method of doing this involves classification by type of device for which the application was developed:

– Personal computer (PC) (server/web-server, portable PC)
– Pocket PC (smartphone), tablet PC, etc.
– Projector (2 Dimensions (2D), possibly 3 Dimensions (3D))
– AR glasses, etc.

Another means of classification is by type of operating system (OS) for which the application has been developed:

– Without OS
– Built-in OS (cars, cameras, etc.)
– Special OS for AR devices
– Mobile device (smartphone, tablet, etc.) OS
– PC OS
– Server OS.

They can also be classified by type of information transmitted by the application:

– Video data
– Audio data
– Text data
– Data required to build 2D and 3D objects on the user's device, or to produce tactile sensations and other data specific to AR devices.

AR applications can be classified by type of AR content delivery from server to AR-client:

– AR video streaming;
– Signalling information;
– Metadata with changes from the previews AR layer of data.

Classification by AR device purpose:

– Sensor
– Actuator.

Sensors might include devices that gather information from the outside world, manipulate it and transmit it for further processing (e.g., AR cameras equipped with, in addition to graphic imaging, devices to measure distance, making it possible to obtain a relief image instead of a flat one, depending on distance from the objects captured).

Actuators include devices that transmit information from the digital world to the physical world or act upon it (e.g., devices displaying information for users of AR glasses and lenses, for example).

7 Augmented reality application testing model

Figure 7-1 shows an AR application testing model.

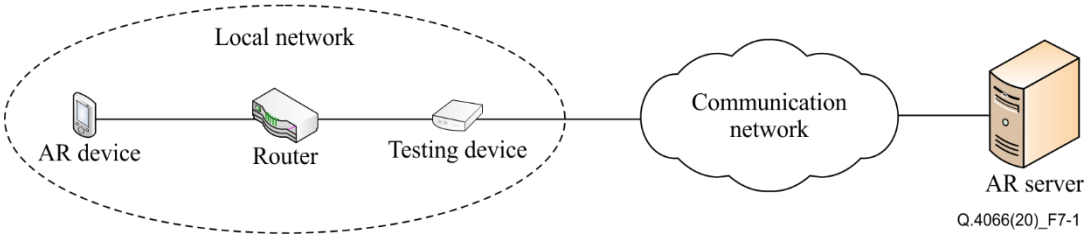

Figure 7-1 – Augmented reality application testing model

This model shows the general architecture of a hardware and software solution for the testing of AR applications. The model comprises:

– AR device – a hardware and software system including pre-installed software for the provision of AR services.

– Router – a router (and/or gateway) connecting the AR device to the global network.

– Testing device – a testing device connected to the router with its own address on the local network and the ability to intercept and analyse traffic between the AR device and AR server.

– AR server – a hardware and software solution in the form of a remote cloud server responsible for monitoring the service delivery procedure.

8 Test specifications for testing various AR applications

To test AR application compatibility with a selected device, network and AR services, it is necessary to specify different testing scenarios. The testing procedure may consist of one or more different test scenarios at the same time. It is defined by the special operation system tools like threads. Each testing procedure may include various different test scenarios by particular thread.

8.1 General procedure for all test scenarios

General procedure for all test scenarios is shown on Figure 8-1.

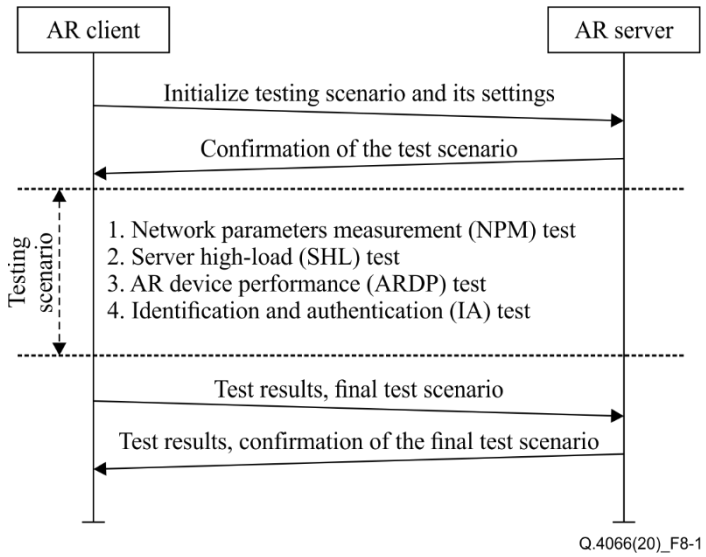

Figure 8-1 – General procedure for all test scenarios

8.2 Network parameters measurement (NPM) test

This testing scenario uses traffic capture opportunity of modern network interfaces to measure QoS parameters for every type of AR application and services. See Figure 8-2.

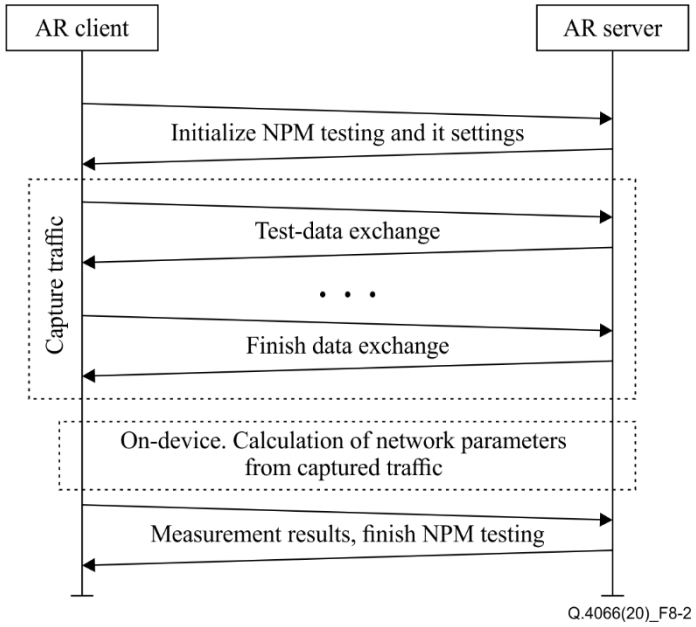

Figure 8-2 – Network parameters measurement testing scenario

8.3 Server high-load (SHL) test

This testing scenario uses OS threads to create high server load values. See Figure 8-3.

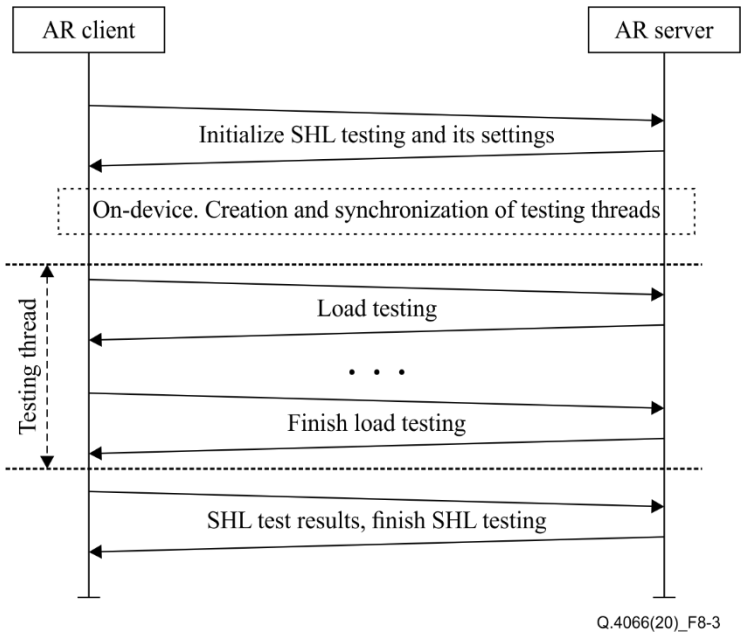

Figure 8-3 – Server high-load testing scenario

8.4 Augmented reality device performance (ARDP) test

This testing scenario is uses embedded on-device OS tools to compare software and hardware requirements with device performance. See Figure 8-4.

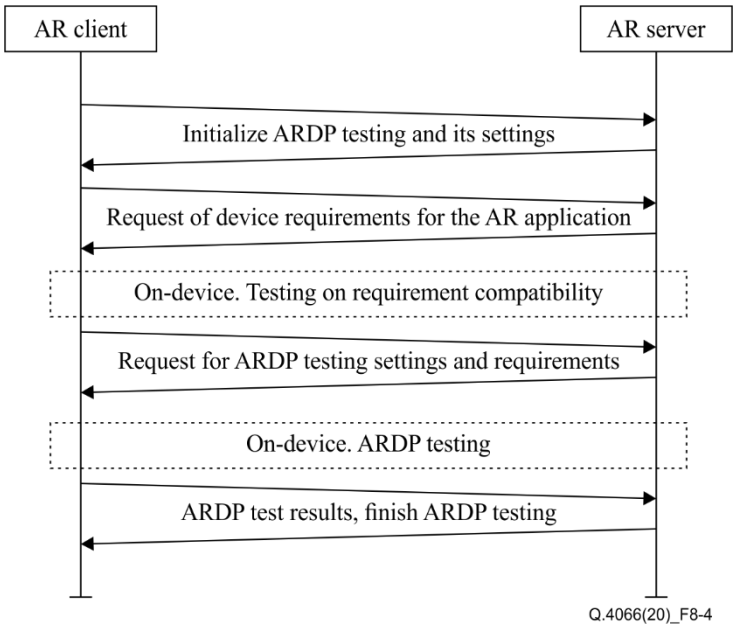

Figure 8-4 – Augmented reality device performance testing scenario

8.5 Identification and authentication (IA) test

This testing scenario uses the certification authority procedure to authenticate server and client validity. See Figure 8-5.

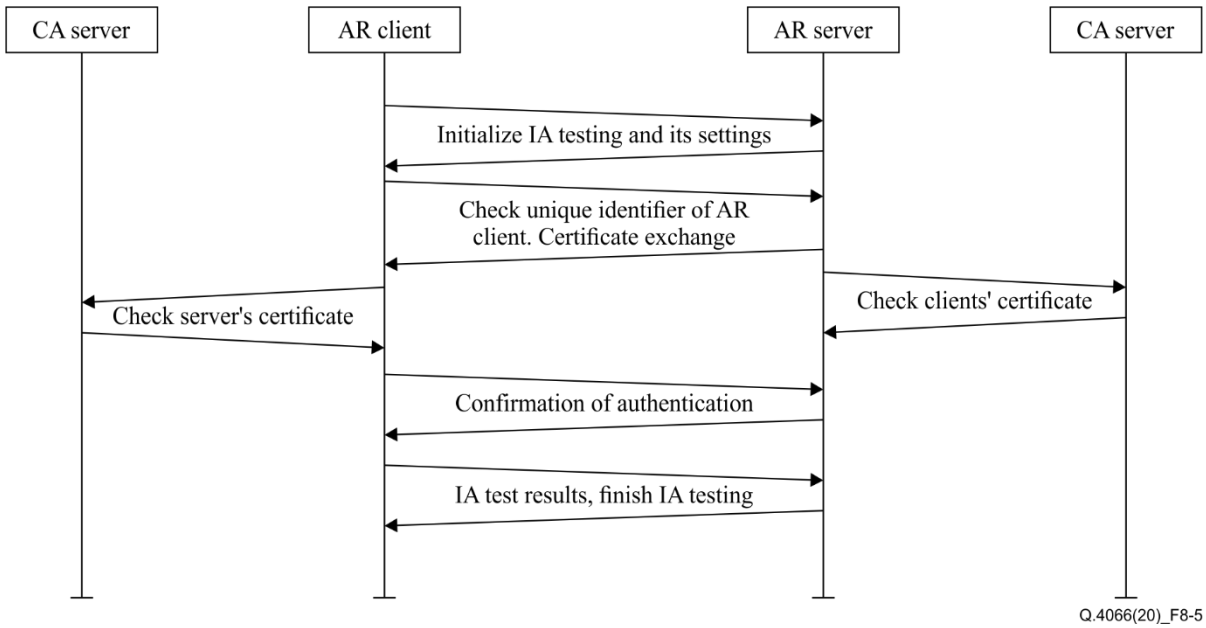

Figure 8-5 – Identification and authentication testing scenario

Appendix I

Valuation models of AR applications network parameters testing

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

To test the performance of AR applications in communication networks, both quality of service (QoS) and quality of experience (QoE) testing methods should be used. In particular, the primary QoS testing criteria should be the four generally accepted QoS parameters:

– Network delays (ms)

– Jitter (ms)

– Network packet loss (%)

– Transmission (bit/s).

QoS parameter values can be determined using the two classifications given in clause 6 :

– By type of data transmitted

– By type of network traffic.

For example, for video and audio information, the QoS parameters set out in [b-ITU-T Y.1541] should be used for voice over IP transmission. In addition, the recommendations contained in [b-ITU-T G.1080] should be followed when testing the performance of AR applications transmitting video data to the user.

For text data and data specific to AR applications, the working scenarios of the applications, established by their developers, should be taken into account. To test the working scenarios of AR applications, a classification according to type of network traffic can be adopted. For example, a reactive scenario is appropriate for an anti-persistent type of network traffic, while a proactive scenario is appropriate for a self-similar type of network traffic.

Bibliography

[b-ITU-T G.1080] Recommendation ITU-T G.1080 (2011), *Quality of experience requirements for IPTV services*.

[b-ITU-T J.301] Recommendation ITU-T J.301 (2014), *Requirements for augmented reality smart television systems*.

[b-ITU-T Y.1541] Recommendation ITU-T Y.1541 (2011), *Network performance objectives for IP-based services*.

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