

International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

P.800.1

(02/2016)

SERIES P: TERMINALS AND SUBJECTIVE AND
OBJECTIVE ASSESSMENT METHODS

Methods for objective and subjective assessment of
speech quality

Mean opinion score (MOS) terminology

Recommendation ITU-T P.800.1



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Recommendation ITU-T P.800.1

Mean opinion score (MOS) terminology

Summary

Recommendation ITU-T P.800.1 provides a terminology which shall be used in conjunction with audio, video and audiovisual quality expressions in terms of mean opinion score (MOS). This terminology is motivated by the intention to avoid misunderstanding as to whether specific values of MOS for audio are related to listening quality, talking quality or conversational quality, whether they originate from subjective tests, from objective models or from network planning models, as well as extending the concept to video and audiovisual quality. Furthermore, this Recommendation provides identifiers regarding the audio bandwidth, the type of interface (electrical or acoustical) and the video resolution. Further guidance on the interpretation of MOS is given in Recommendation ITU-T P.800.2.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T P.800.1	2003-03-16	12	11.1002/1000/6257
2.0	ITU-T P.800.1	2006-07-14	12	11.1002/1000/8860
3.0	ITU-T P.800.1	2016-02-29	12	11.1002/1000/12749

* 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>.

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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.

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Recommendation ITU-T P.800.1

Mean opinion score (MOS) terminology

1 Scope

This Recommendation provides a terminology which shall be used in conjunction with audio, video and audio-visual quality expressions in terms of mean opinion score (MOS).

2 References

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

- [ITU-T G.107] Recommendation ITU-T G.107 (2015), *The E-model, a computational model for use in transmission planning.*
- [ITU-T G.113 Ap.I] Recommendation ITU-T G.113 (2007), Appendix I, *Provisional planning values for the equipment impairment factor, I_e, and packet-loss robustness factor, B_{pl}.*
- [ITU-T G.1070] Recommendation ITU-T G.1070 (2012), *Opinion model for video-telephony applications*
- [ITU-T G.1071] Recommendation ITU-T G.1071 (2015), *Opinion model for network planning of video and audio streaming applications.*
- [ITU-T J.140] Recommendation ITU-T J.140 (1998), *Subjective picture quality assessment for digital cable television systems.*
- [ITU-T J.144] Recommendation ITU-T J.144 (2004), *Objective perceptual video quality measurement techniques for digital cable television in the presence of a full reference.*
- [ITU-T J.247] Recommendation ITU-T J.247 (2008), *Objective perceptual multimedia video quality measurement in the presence of a full reference*
- [ITU-T J.341] Recommendation ITU-T J.341 (2016), *Objective perceptual multimedia video quality measurement of HDTV for digital cable television in the presence of a full reference*
- [ITU-T P.10] Recommendation ITU-T P.10/G.100 (2006), *Vocabulary for performance and quality of service.*
- [ITU-T P.562] Recommendation ITU-T P.562 (2004), *Analysis and interpretation of INMD voice-service measurements.*
- [ITU-T P.563] Recommendation ITU-T P.563 ((2004), *Single-ended method for objective speech quality assessment in narrow-band telephony applications.*
- [ITU-T P.800] Recommendation ITU-T P.800 (1996), *Methods for subjective determination of transmission quality.*
- [ITU-T P.800.2] Recommendation ITU-T P.800.2 (2013), *Mean opinion score interpretation and reporting*

- [ITU-T P.830] Recommendation ITU-T P.830 (1996), *Subjective performance assessment of telephone-band and wideband digital codecs.*
- [ITU-T P.831] Recommendation ITU-T P.831 (1998), *Subjective performance evaluation of network cancellers.*
- [ITU-T P.832] Recommendation ITU-T P.832 (2000), *Subjective performance evaluation of hands-free terminals.*
- [ITU-T P.833] Recommendation ITU-T P.833 (2001), *Methodology for the derivation of equipment impairment factors from subjective listening-only tests.*
- [ITU-T P.834] Recommendation ITU-T P.834 (2015), *Methodology for the derivation of equipment impairment factors from instrumental models.*
- [ITU-T P.835] Recommendation ITU-T P.835 (2003), *Subjective test methodology for evaluating speech communication systems that include noise suppression algorithm.*
- [ITU-T P.840] Recommendation ITU-T P.840 (2003), *Subjective listening test method for evaluating circuit multiplication equipment.*
- [ITU-T P.862] Recommendation ITU-T P.862 (2001), *Perceptual evaluation of speech quality (PESQ): An objective method for end-to-end speech quality assessment of narrow-band telephone networks and speech codecs.*
- [ITU T P.862.1] Recommendation ITU-T P.862.1 (2003), *Mapping function for transforming P.862 raw result scores to MOS-LQO.*
- [ITU-T P.862.2] Recommendation ITU-T P.862.2 (2007), *Wideband extension to Recommendation P.862 for the assessment of wideband telephone networks and speech codecs.*
- [ITU-T P.863] Recommendation ITU-T P.863 (2014), *Perceptual objective listening quality assessment*
- [ITU-T P.910] Recommendation ITU-T P.910 (2008), *Subjective video quality assessment methods for multimedia applications.*
- [ITU-T P.911] Recommendation ITU-T P.911 (1998), *Subjective audiovisual quality assessment methods for multimedia applications.*
- [ITU-T P.912] Recommendation ITU-T P.912 (2016), *Subjective video quality assessment methods for recognition tasks.*
- [ITU-T P.913] Recommendation ITU-T P.913 (2016), *Methods for the subjective assessment of video quality, audio quality and audiovisual quality of Internet video and distribution quality television in any environment.*
- [ITU-T P.920] Recommendation ITU-T P.920 (2000), *Interactive test methods for audiovisual communications.*
- ITU-T P.1201] Recommendation ITU-T P.1201 (2012), *Parametric non-intrusive assessment of audiovisual media streaming quality.*
- [ITU-T P.1202] Recommendation ITU-T P.1202 (2012), *Parametric non-intrusive bitstream assessment of video media streaming quality.*
- [ITU-T P.1301] Recommendation ITU-T P.1301 (2012), *Subjective quality evaluation of audio and audiovisual multiparty telemeetings.*
- [ITU-R BT.500] Recommendation ITU-R BT.500 (2012), *Methodology for the subjective assessment of the quality of television pictures.*

- [ITU-R BT.709-6] Recommendation ITU-R BT.709-6 (2015), *Parameter values for the HDTV standards for production and international programme exchange.*
- [ITU-R BT.2020-2] Recommendation ITU-R BT.2020 (2015), *Parameter values for ultra-high definition television systems for production and international programme exchange.*

3 Definitions

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACR	Absolute Category Rating
HD	High Definition
IRS	Intermediate Reference System
MOS	Mean Opinion Score
SD	Standard Definition
UHD	Ultra High Definition

5 Conventions

In this Recommendation the following conventions are used:

MOS-AVQE is used to refer to MOS estimated audiovisual quality;
MOS-AVQO is used to refer to MOS objective audiovisual quality;
MOS-AVQS is used to refer to MOS subjective audiovisual quality;
MOS-CQE is used to refer to MOS estimated conversational quality;
MOS-CQO is used to refer to MOS objective conversational quality;
MOS-CQS is used to refer to MOS subjective conversational quality;
MOS-LQE is used to refer to MOS estimated listening quality;
MOS-LQO is used to refer to MOS objective listening quality;
MOS-LQS is used to refer to MOS subjective listening quality;
MOS-TQE is used to refer to MOS estimated talking quality;
MOS-TQO is used to refer to MOS objective talking quality;
MOS-TQS is used to refer to MOS subjective talking quality;
MOS-VQE is used to refer to MOS estimated video quality;
MOS-VQO is used to refer to MOS objective video quality;
MOS-VQS is used to refer to MOS subjective video quality.

6 Recommended MOS terminology for audio

The mean opinion score (MOS) is defined in [ITU-T P.10] in the following way:

- The mean of opinion scores, i.e., of the values on a predefined scale that subjects assign to their opinion of the performance of the telephone transmission system used either for conversation or for listening to spoken material.

Apart from subjective opinion, the abbreviation MOS is also used for scores that originate from objective models or network planning models. The following identifiers, listed in Table 1, are recommended to be used together with the abbreviation MOS in order to distinguish the area of application, where N refers to 'narrow-band', W refers to 'wideband', LQ refers to 'listening quality', CQ refers to 'conversational quality', TQ refers to talking quality, S refers to 'subjective', O refers to 'objective', and E refers to 'estimated'. For the purposes of this Recommendation, the term 'Audio' for this clause primarily relates to speech quality.

Table 1 – Audio identifiers

	Listening-only	Conversational	Talking
Subjective	MOS-LQSy	MOS-CQSy	MOS-TQSy
Objective	MOS-LQOy	MOS-CQOy	MOS-TQOy
Estimated	MOS-LQEy	MOS-CQEy	MOS-TQEy

NOTE – The letter "y" at the end of above acronyms is a placeholder for the descriptor of the respective audio bandwidth, see the following provisional instructions.

- N for MOS scores obtained for narrow-band (300-3400 Hz) speech relative to a narrow band high quality reference. This is applicable for instance to narrow-band only subjective tests or to ITU-T P.862.1 or ITU-T P.863 (narrow-band operational mode) scores.
- W for MOS scores obtained for wideband (50-7000 Hz) speech relative to a wideband high quality reference. This is applicable for instance to wideband only subjective tests or to ITU-T P.862.2 scores.
- M for MOS scores obtained for narrow-band or wideband speech relative to a wideband high quality reference in a mixed bandwidths context. This is applicable for instance to mixed bandwidths subjective tests.

The effects of audio bandwidth on MOS scores are currently under investigation in ITU-T Study Group 12. In cases where the bandwidth denominators N, W or M do not properly reflect the actual situation, it is suggested that provisionally the placeholder "y" be replaced by a proper notation.

6.1 MOS related to listening-only situations

These MOS scores are applicable to a listening-only situation. Three different cases have to be distinguished.

6.1.1 MOS-LQS

The score has been collected in a laboratory test by calculating the arithmetic mean value of subjective judgments on a 5-point absolute category rating (ACR) quality scale, as it is defined in [ITU-T P.800]. Subjective tests carried out according to [ITU-T P.830], [ITU-T P.835] and [ITU-T P.840] give results in terms of MOS-LQS.

6.1.2 MOS-LQO

The score is calculated by means of an objective model which aims at predicting the quality for a listening-only test situation. Objective measurements made using the models given in [ITU-T P.862.1], [ITU-T P.862.2] and [ITU-T P.863] give results in terms of MOS-LQO.

In this context, it should be noted that there is a necessary distinction between intrusive end-to-end measurements of listening quality aiming at:

- **MOS-LQO (electrical)**

This kind of measurement is performed at electrical interfaces only. In order to predict the listening quality as perceived by the user, assumptions for the terminals are made in terms of intermediate reference system (IRS) or corrected IRS frequency response; this implicitly includes the assumption of a sealed condition between the handset receiver and the user's ear. [ITU-T P.862] falls into this category.

- **MOS-LQO (acoustical)**

This kind of measurement is performed at acoustical interfaces. In order to predict the listening quality as perceived by the user, this measurement includes the actual telephone set products provided by the manufacturer or vendor. In combination with the choice of the acoustical receiver in the laboratory test ("artificial ear"), there will be a more or less leaky condition between the handset's receiver and the artificial ear. Consequently, for more realistic test scenarios, there may be a degradation of the measured MOS value, while for more artificial test scenarios there may be a negligible difference.

6.1.3 MOS-LQE

The score is calculated by a network planning model which aims at predicting the quality in a listening-only application situation.

6.2 MOS related to conversational situations

These MOS scores are applicable to a conversational situation. Three different cases have to be distinguished.

6.2.1 MOS-CQS

The score has been collected in a laboratory test by calculating the arithmetic mean value of subjective judgments on a 5-point ACR quality scale, as it is defined in [ITU-T P.800]. Subjective conversation tests carried out according to [ITU-T P.800], [ITU-T P.831] and [ITU-T P.832] give results in terms of MOS-CQS.

6.2.2 MOS-CQO

The score is calculated by means of an objective model which aims at predicting the quality for a conversational test situation. Objective measurements made using the model given in [ITU-T P.562] and [ITU-T P.563] give results in terms of MOS-CQO.

6.2.3 MOS-CQE

The score is calculated by a network planning model which aims at predicting the quality in a conversational application situation. Estimates of conversational quality carried out according to [ITU-T G.107], when transformed to mean opinion score, give results in terms of MOS-CQE.

6.3 MOS related to talking situations

Talking quality describes the quality of a telephone call as it is perceived by the talking party only. Talking quality will be mainly affected by the annoyance of the echo signal and effects like background noise switching and double talk.

6.3.1 MOS-TQS

The score has been collected in a laboratory test by calculating the arithmetic mean value of subjective judgments on a 5-point ACR quality scale, as it is defined in [ITU-T P.800].

6.3.2 MOS-TQO

The score is calculated by means of an objective model which aims at predicting the quality for a talking-only test situation. Methods generating a MOS-TQO are currently under development and not yet standardized.

6.3.3 MOS-TQE

The score is calculated by a network planning model which aims at predicting the quality in a talking-only application situation. No methods generating a MOS-TQE are currently standardized.

6.4 Relationship between some audio MOS qualifiers

Figure 1 gives an overview of the relation between MOS-LQS, MOS-LQO and MOS-LQE.

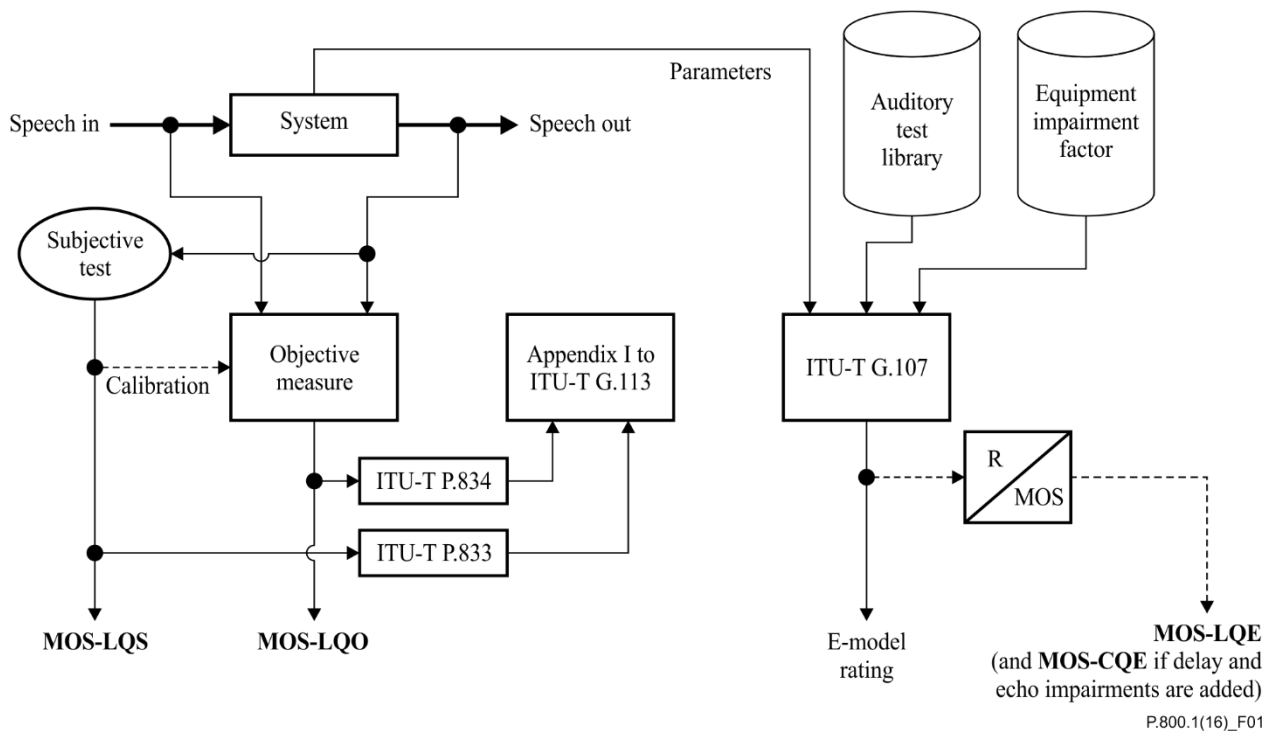


Figure 1 – Relationship between some audio MOS qualifiers

7 Recommended MOS terminology for video

The following identifiers, listed in Table 2, are recommended to be used together with the abbreviation MOS in order to distinguish the area of application of MOS for video, where VQ refers to 'video quality', S refers to 'subjective', O refers to 'objective' and E refers to 'estimated'. As noted in [ITU-T P.800.2], display resolution also has an influence on the absolute value of video MOS.

Table 2 – Video identifiers

	Video
Subjective	MOS-VQSZ
Objective	MOS-VQOZ
Estimated	MOS-VQEZ

NOTE – The letter "z" at the end of above acronyms is a placeholder for the descriptor of the respective video resolution, see the following provisional instructions.

- S for MOS scores obtained for standard definition (SD) video relative to a SD video reference.
- H for MOS scores obtained for high definition (HD) video relative to a HD video reference (where HD is defined in [ITU-R BT.709-6]).
- U for MOS scores obtained for ultra high definition (UHD) video relative to a UHD video reference (where UHD is defined in [ITU-R BT.2020-2]).
- M for MOS scores obtained for SD or HD or UHD video relative to an UHD video reference in a mixed resolution context. This is applicable, for instance, to mixed definition subjective tests.

The effect of video resolution on MOS scores is currently under investigation in ITU-T Study Group 12. In cases where the resolution denominators S, H, U or M do not properly reflect the actual situation, it is suggested that provisionally the placeholder "z" be replaced by a proper notation.

7.1 MOS-VQS

The score has been collected in a laboratory test by calculating the arithmetic mean value of subjective judgments, typically on a 5-point quality scale. Subjective tests carried out according to [ITU-T P.910], [ITU-T P.912], [ITU-T P.913], [ITU-T P.920], [ITU-T J.140] and [ITU-R BT.500] are examples of such models.

7.2 MOS-VQO

MOS-VQO refers to objective video quality, which represents the MOS score obtained from an algorithmic quality evaluation model. The evaluation model uses real-time objective metrics that can be obtained from information carried in the video streams and corresponding networks and may be full-reference and no-reference. [ITU-T J.144], [ITU-T J.247], [ITU-T J.341], [ITU-T P.1201], [ITU-T P.1202] are examples of such models.

7.3 MOS-VQE

The score is calculated by a network planning model which aims at predicting the quality in a video application situation, based on non real-time parameters. [ITU-T G.1070] and [ITU-T G.1071] are examples of such models.

7.4 Relationship between some video MOS qualifiers

Figure 2 gives an overview of the relation between MOS-VQS, MOS-VQO and MOS-VQE.

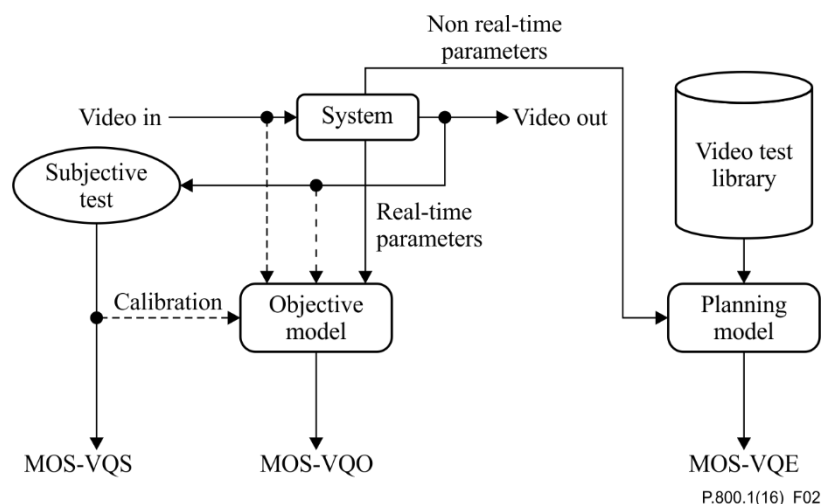


Figure 2 – Relationship between some video MOS qualifiers

8 Recommended MOS terminology for audiovisual

The following identifiers, listed in Table 3, are recommended to be used together with the abbreviation MOS in order to distinguish the area of application of MOS for audiovisual, where AVQ refers to 'audiovisual quality', i.e., a single score taking into account the combination of audio and video quality. S refers to 'subjective', O refers to 'objective' and E refers to 'estimated'.

Table 3 – Audiovisual identifiers

	Video
Subjective	MOS-AVQSy _z
Objective	MOS-AVQOy _z
Estimated	MOS-AVQEy _z

NOTE – The letter "y" at the end of above acronyms is a placeholder for the descriptor of the respective audio bandwidth in the audiovisual combination, see the following provisional instructions.

- N for MOS scores obtained for narrow-band (300-3400 Hz) speech relative to a narrow-band high quality reference. This is applicable for instance to narrow-band only subjective tests or to ITU-T P.862.1 and ITU-T P.863 (narrow-band operational mode) scores.
- W for MOS scores obtained for wideband (50-7000 Hz) speech relative to a wideband high quality reference. This is applicable for instance to wideband only subjective tests or to ITU-T P.862.2 scores.
- M for MOS scores obtained for narrow-band or wideband speech relative to a wideband high quality reference in a mixed bandwidths context. This is applicable for instance to mixed bandwidths subjective tests.

The effect of audio bandwidth on MOS scores is currently under investigation in ITU-T Study Group 12. In cases where the bandwidth denominators N, W or M do not properly reflect the actual situation, it is suggested that provisionally the placeholder "y" be replaced by a proper notation.

The letter "z" at the end of above acronyms is a placeholder for the descriptor of the respective video resolution in the audiovisual combination, see the following provisional instructions.

- S for MOS scores obtained for SD video relative to a SD video reference.
- H for MOS scores obtained for HD video relative to a HD video reference.
- U for MOS scores obtained for UHD video relative to a UHD video reference.

- M for MOS scores obtained for SD or HD or UHD video relative to an UHD video reference in a mixed resolution context. This is applicable, for instance, to mixed definition subjective tests.

The effect of video resolution on MOS scores is currently under investigation in ITU-T Study Group 12. In cases where the resolution denominators S, H, U or M do not properly reflect the actual situation, it is suggested that provisionally the placeholder "z" be replaced by a proper notation.

A further distinction for audiovisual MOS can be made between one-way (i.e., streaming) and two-way (i.e., conversational) applications.

8.1 MOS-AVQS

The score has been collected in a laboratory test by calculating the arithmetic mean value of subjective judgments, typically on a 5-point quality scale. Subjective tests carried out according to [ITU-T P.911], [ITU-T P.913], [ITU-T P.920] and [ITU-T P.1301] are examples of such models.

8.2 MOS-AVQO

MOS-VQO refers to objective audiovisual quality, which represents the MOS score obtained from an algorithmic quality evaluation model. The evaluation model uses real-time objective metrics that can be obtained from information carried in the audiovisual streams and corresponding networks and may be full-reference and no-reference. [ITU-T P.1201] and [ITU-T P.1202] are examples of such models.

8.3 MOS-AVQE

The score is calculated by a network planning model which aims at predicting the quality in an audiovisual application situation, based on non real-time parameters. [ITU-T G.1070] is an example of a model providing a two-way MOS-AVQE score, while [ITU-T G.1071] is an example of a model giving a one-way MOS-AVQE score.

8.4 Relationship between some audiovisual MOS qualifiers

Figure 3 gives an overview of the relation between MOS-AVQS, MOS-AVQO and MOS-AVQE.

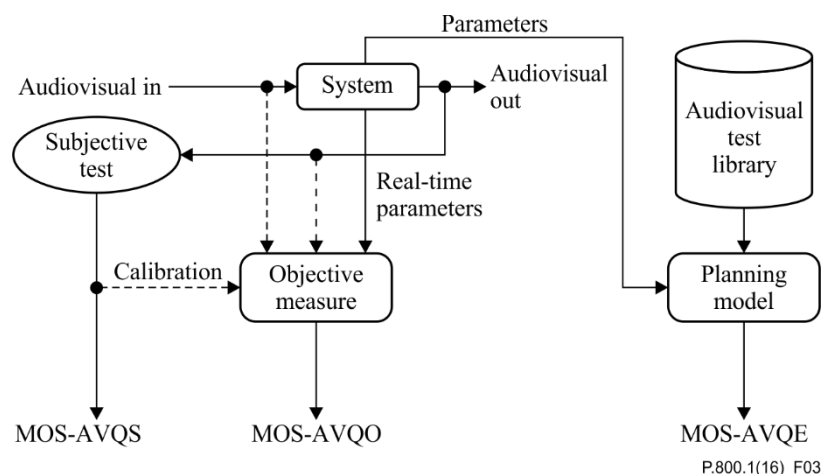


Figure 3 – Overview of the relation between MOS-AVQS, MOS-AVQO and MOS-AVQE

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