



IRG-AVQA

Intersector Rapporteur Group Audiovisual Quality Assessment

VQEG, Spring Meeting, July 4th 2024

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Alexander Raake, Audiovisual Technology (AVT), I3TC, TU Ilmenau



IRG-AVQA Overview

IRG-AVQA studies topics related to video and audiovisual quality assessment among ITU-R SG6 and ITU-T SG12

IRG-AVQA aims to:

- coordinate progress of specific topics of mutual interest restricted to area of video and audiovisual quality assessment, both subjective and objective;
- identify potential work items that may be progressed as joint text Recommendations;
- benefit from colocation with meetings of Video Quality Experts Group (VQEG) where video/audiovisual quality experts meet and execute technical work;
- encourage collaboration between ITU-T SG12 and ITU-R SG6 on work items unique to each study group.



IRG-AVQA allows Rapporteurs to

- exchange information faster, using email and joint meetings;
- seek participation from a broader range of ITU members;
- invite input from non-member experts (e.g., from academia);
- keep people informed at the early stage of work;
- set up a joint edit session on a Recommendation;
- socialize work items that approach maturity;
- Participants who can contribute technology proposals are invited and encouraged to join the group.



IRG-AVQA Co-chairs

- Chulhee Lee (Korea, Rep. of)
- Alexander Raake (Germany)



ITU-R WP6C



IRG-AVQA@VQEG, July 4, 2024, C. Lee & A. Raake



ITU-R – Some Contributions (March 2024)

- C23 - A subjective analysis of the discomfort duration in brightness transitions in high dynamic range media
- C22 - Working document towards a preliminary draft new Recommendation ITU-R BT.[REQ-MIL][REQ-IL] - Requirements and applications for Image Level meters
- C11 - AI-based no-reference (NR) video quality measurement methods
- C8 - Proposed draft revision of Report ITU-R BT.2506-0 - Requirements for spatial characteristics of an ideal head-mounted display for immersive video



ITU-R WP6C Status of texts under development



Study Group 6 - Status of texts under development

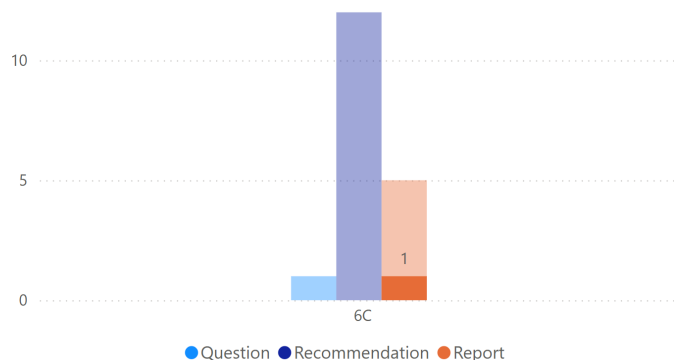
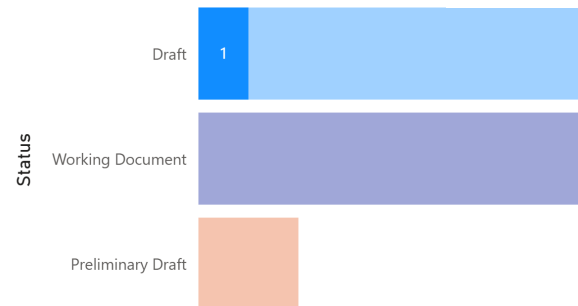


6C

Report

Subject

- ☐ Advanced sound systems
- ☐ Energy-Aware Broadcasting
- ☐ High dynamic range television (HDR-TV)
- ☐ Immersive Video
- ☐ Production of Ultra-High Definition Televis...
- ☐ Quality Evaluation Methods
- ☐ Video Quality Assessment



WP	Subject	Status	Proposal	Type	Doc	Begin date	Target date
6C	Advanced sound systems	Draft	Revision	Report	ITU-R BT.2420-5 - Collection of usage scenarios of advanced immersive sensory media systems	Mar. 2023	Mar. 2024
6C	Advanced sound systems	Working Document	Revision	Recommendation	ITU-R BS.1283-2 - Guidance for the selection of the most appropriate ITU-R Recommendation(s) for subjective assessment of sound quality	Mar. 2024	Mar. 2025
6C	Advanced sound systems	Working Document	Revision	Recommendation	ITU-R BS.1679-1 - Subjective assessment of the quality of	Mar. 2024	Mar. 2025

ITU-R – Current Work Items (Video)

- **Preliminary draft revision of Recommendation ITU-R BT.1662** - General reference chain and management of post-processing headroom for programme essence in large screen digital imagery applications
- **Preliminary draft revision of Recommendation ITU-R BT.1666** - User requirements for large screen digital imagery applications intended for presentation in a theatrical environment
- **WD-PDNR ITU-R BT.[MF3]** A measurement framework for broadcasters to assess their Scope 3 impact of televisions displaying a television programme
- **DRAFT REVISION OF REPORT ITU-R BT.2506-0** Requirements for spatial characteristics of an ideal head-mounted display for immersive video



ITU-R – Current Work Items (HDR)

- **WD preliminary draft revision of Recommendation ITU-R BT.2100-2** - Image parameter values for high dynamic range television for use in production and international programme exchange
- **WD preliminary draft new Recommendation ITU-R BT.[REQ-MIL]** - Requirements and applications for Image Level meters
- **WD a preliminary draft new Recommendation ITU-R BT.[MON]** - [Reference] viewing conditions for HDR and SDR monitoring in close proximity within a single-master broadcast production environment
- **WD a preliminary draft revision of Report ITU-R BT.2408** - Guidance for operational practices in HDR television production



ITU-T SG12



ITU-T – Overview of Last Meetings

ITU-T SG12 (Geneva, Switzerland)

- SG12 organized as Questions
- Covered meetings
 - SG12 Meeting: 16-25 April 2024



ITU-T SG12 – Q7

Rapporteur: Ludovic Malfait

- **Methodologies, tools and test plans for the subjective assessment of speech, audio and audiovisual quality interactions**
- **Worlk items**
 - **P.835ref**: Subjective test methodology for evaluating speech communication systems that include noise suppression algorithm
 - **P.PHYSIO**: Use of physiological measures as an additional test method for speech quality assessment
 - **PSTR.OUTLAB**: Conducting subjective tests outside of the lab

Contributions (April 2024)

- C186 - Gender-related aspects analysis of voice transmissions for listening quality optimization
- C222 - Comparison of voice quality estimations between subjective and objective evaluations on neural audio coders
- C226r1 - ITU-T P.IntVR: "Subjective Test Method for Interactive Virtual Reality Applications" - Completed with Terms, Abbreviations and Bibliography
- C232 - Draft revised Recommendation ITU-T P.835: Subjective test methodology for evaluating speech communication systems that include noise suppression algorithm



ITU-T SG12 – Q9

Rapporteur: Jens Berger

- **Perceptual-based objective methods and corresponding evaluation guidelines for voice and audio quality measurements in telecommunication services**
- **Work items**
 - **P. SAMD:** Single-ended perceptual approaches for multi-dimensional analysis
 - **P.TCA:** Technical cause analysis

Contributions (April 2024)

- C186 - Gender-related aspects analysis of voice transmissions for listening quality optimization
- C197 - Proposed post-mapping for the four P.863.2-dimension predictions
- C215r1 - Initiating a new technical report on End-to-End Audio Quality Assessment for Internet Real-Time Communication Services
- C222 - Comparison of voice quality estimations between subjective and objective evaluations on neural audio coders
- C227 - P.SAMD databases
- C239 - Progress of P.SAMD model



ITU-T SG12 – Q10

Rapporteurs: Gunilla Berndtsson, Janto Skowronek

- **Conferencing and telemeeting assessment**
- **Wortk items**
 - **P.IXC:** Interactive test methods for subjective assessment of extended reality communications
→ collaboration with VQEG IMG
 - **P.UXV:** User experience of multimedia in videotelephony and videoconferencing services

Contributions (April 2024)

- C208 – Base text for P.UXV: User Experience of multimedia in videotelephony and videoconferencing services, China Mobile Communications Co. Ltd., Orange (France)
- C241 – Information about standardization work of relevance for assessment of XR meetings, updated March 2024, Centrum Wiskunde & Informatica (Netherlands (Kingdom of the)), Nokia Corporation (Finland), Telefon AB - LM Ericsson (Sweden)
- C214 – Proposed new work item on "Quality evaluation framework of extended reality terminal", China Telecommunications Corporation, Guangdong OPPO Mobile Telecommunications Corp., Ltd. (China), Ministry of Industry and Information Technology (MIIT) (China), Vivo Mobile Communication Co., Ltd. (China)
- C199 – First draft of P.IXC "Interactive test methods for subjective assessment of extended reality communications", Nokia Corporation (Finland) , Blekinge Institute of Technology (Sweden) , Centrum Wiskunde & Informatica (Netherlands (Kingdom of the)) , Ilmenau University of Technology (TU Ilmenau) (Germany), Telefon AB - LM Ericsson (Sweden), University of Surrey Institute for Communication Systems(ICS) (United Kingdom)

ITU-T SG12 – Q13

Rapporteur: Kazuhisa Yamagishi

- **Quality of experience (QoE), quality of service (QoS) and performance requirements and assessment methods for multimedia applications**
- **Work items**
 - **P.SMAR:** Subjective Tests for Evaluating the User Experience for Mobile AR Applications
 - **G.MF-VR:** Measurement of quality influencing factors for virtual reality services

Contributions (April 2024)

- C192 - Proposed edits to P.SMAR: Rating scales for key parameters and test environment and equipment
- C198 - Measuring Quality Influencing Factors of Virtual Reality Services
- C202 - Assessing the Impact of LTE and 5G Networks on Virtual Reality Experience



ITU-T SG12 – Q14

Rapporteurs: Jörgen Gustafsson, Alexander Raake

- **Development of models and tools for multimedia quality assessment of packet-based video services**
- **Work items**
 - **P.1204.1** Extend P.1204 recommendations with support for new codecs
 - **P.1204.2** Video quality assessment of streaming services over reliable transport for resolutions up to 4K with access to video frame information
 - **P.BBQCG** Parametric bitstream-based Quality Assessment of Cloud Gaming Services
 - **P.NAMS-Codec-Ext** Parametric Non-intrusive Bitstream Assessment for High Efficiency Video Coding (HEVC) and 4K Media Streaming Quality over UDP
 - **P.NATS-ph3** Quality integration module for adaptive video streaming QoE in the context of P.120X-Recommendation series
 - **PSTR-OQMXR** Objective quality modelling for XR services

Contributions (April 2024)

- C194 – Validation Results of User Interactivity Model for Cloud Gaming Over Mobile Networks
- C200 – Preliminary Results of User Interactivity Model for Cloud Gaming Over Mobile Networks for VR ...
- C228 – Candidate Model for P.BBQCG: Passive Video Quality
- C229 – Second draft of the technical report PSTR-OQMXR
- C230 – P.BBQCG project status and time plan



ITU-T SG12 – Q14 (ctd.)

P.1204.X Codec extension

- P.1204.4 and P.1204.5 have been extended to AV1, cf. Recommendations
- P.1204.3 is ongoing, to be finished Q1/2024
- Further extensions desirable, e.g., VVC
- New work items HDR, 8K, ...
 - collaboration VQEG, e.g., AVHD?
(following successful P.NATS Phase 2 work)

P.NATS Phase 3 / P.MOSQUITO

- Overarching long-term (up to 5min) and a/v integration module
- Initial work stream including “quitting” not currently pursued (subjective test method: MOSQUITO)



ITU-T SG12 – Q14 (ctd.)

P.BBQCG - Parametric bitstream-based Quality Assessment of Cloud Gaming Services

- “Active” and “passive” work streams
- Regular sub-group meetings Mon 16-17 CET, Wed 14-15h CET
- “Passive”
 - Tests mostly concluded, report and paper in preparation
- “Active”
 - Currently work for pre-tests and initial tests underway. specifically addressing possible test environment candidates
- Work group expands beyond typical Q14 collaborations, good collaborations with VQEG

Contributions

- C194 – Validation Results of an User Interactivity Model for Cloud Gaming Over Mobile Networks, InfoVista SAS (France), Q14/12
- C200 – Preliminary Results of User Interactivity Model for Cloud Gaming Over Mobile Networks for VR use case, InfoVista SAS (France), Q14/12
- C228 – Candidate Model for P.BBQCG: Passive Video Quality, Ilmenau University of Technology (TU Ilmenau) (Germany), Telefon AB - LM Ericsson (Sweden)
- C230 – P.BBQCG project status and time plan, Telefon AB - LM Ericsson (Sweden)



ITU-T SG12 – Q14 (ctd.)

PSTR-OQMXR - Objective quality modelling for XR services

- Still under specification
 - Rather wide landscape of services and solutions
 - Technology not as mature as for, e.g., video streaming
- Links with Q10/12 (interactive services) and VQEG IMG
- Request for interested parties from VQEG?

Contributions

- C229 - Second draft of the technical report PSTR-OQMXR
Rohde & Schwarz GmbH & Co. KG (Germany), Telefon AB - LM Ericsson (Sweden)



ITU-T SG12 – Q15

Rapporteurs: Vincent Barriac, Sebastian Möller, Joachim Pomy

- **Parametric and E-model-based planning, prediction and monitoring of conversational speech and audio-visual quality**
- **Work items**
 - **G.CMVTQS:** Computational model used as a QoE/QoS monitor to assess videotelephony services
 - **P.834.2:** Extension of the methodology for the derivation of equipment impairment factors from instrumental models for super-wideband and fullband speech codecs

Contributions (April 2024)

- C187 – Proposed Amendment of Rec. G.113 Appendices
- C206 – G.CMVTQS: Updated test protocol of subjective tests
- C207 – Base text for G.CMVTQS: Computational model used as a QoE/QoS monitor to assess videotelephony services
- C222 – Comparison of voice quality estimations between subjective and objective evaluations on neural audio coders
- C223 – Evaluation of the procedure of Draft Rec. P.833.2 on data provided in Draft ETSI TS 103 624 V1.6.
- C224 – Draft Rec. P.834.2 "Extension of the methodology for the derivation of equipment impairment factors from instrumental models for fullband speech codecs"



ITU-T SG12 – Q19

Rapporteur: Chulhee Lee

- **Objective and subjective methods for evaluating perceptual audiovisual quality in multimedia and television services**
- **Worlk items**
 - **J.noref:** Perceptual video quality measurement techniques for digital cable television in the absence of a reference
 - **J.src-vq:** Objective Assessment Methods for Source Video Quality at the Headend
 - **J.q-uhd:** Quality measurement methods for UHD services
 - **P.obj-recog:** Estimation techniques of object-recognition rate in surveillance video of autonomous driving

Contributions (April 2024)

- C203 - Draft Terms of Reference (ToR) P.obj-recog
- C204 - Draft Test plan of P.obj-recog
- C205 - P.obj-recog experimental result
- C211 - Reliability of No-Reference Video Quality Assessment Methods in the Development of J.noref
- C212 - Progress of J.q-uhd and J.src-vq
- C216 - Proposal for a new metric to describe image intelligibility



Upcoming ITU Meetings

- **2024 ITU-R SG6 WP6C Meeting**
 - 4-8 November 2024 (Geneva)
- **2024 ITU-T SG12 WP3 Meeting**
 - 29 August 2024 (Virtual meeting)
- **2024 ITU-T SG12 Q13 + Q14/12 Interim Meeting**
 - 27-29 August 2024 (Karlshamn, Sweden; Host: BTH)



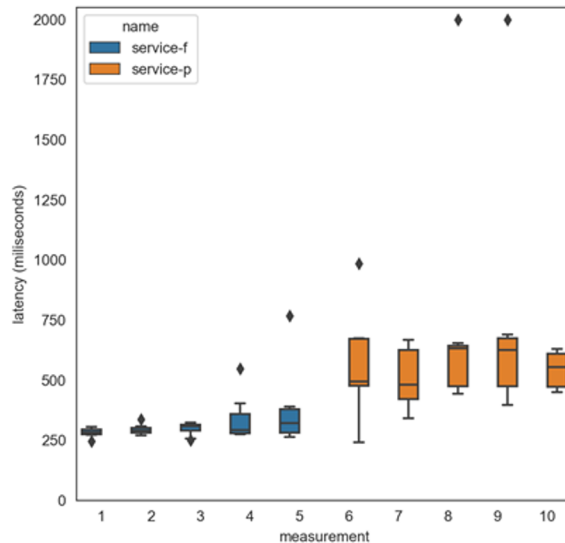
Selected Details

Subjective Quality Assessment

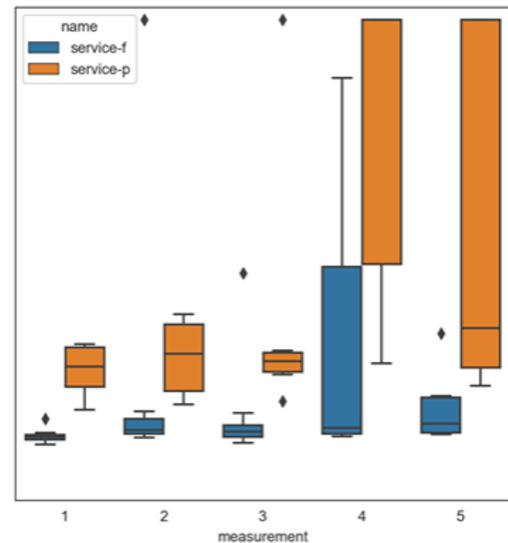


C198, Rohde & Schwarz - Measuring Quality Influencing Factors of Virtual Reality Services (1)

- 2 VR services considered
 - Consisted of cloud rendered VR environment with one main object
 - User interaction → looking at the object at different angles + moving closer/farther
- Measurements → viewing on a smartphone
 - Same methodology can be used for HMD viewing



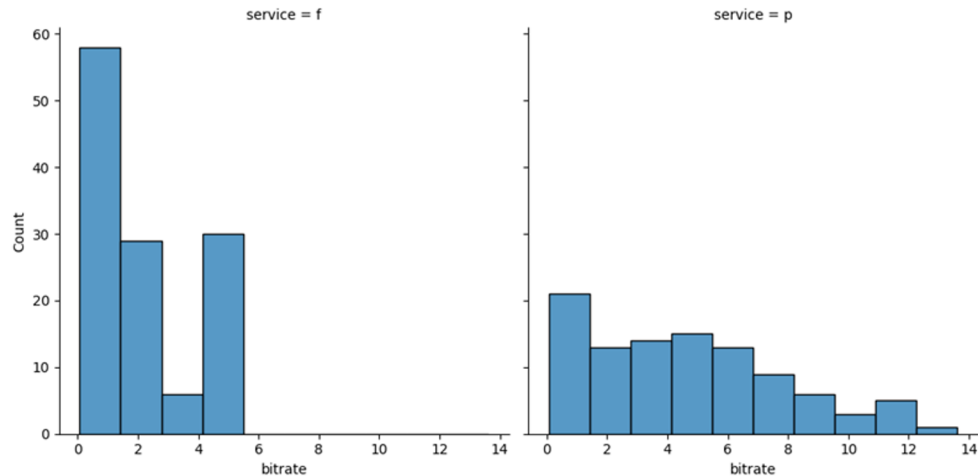
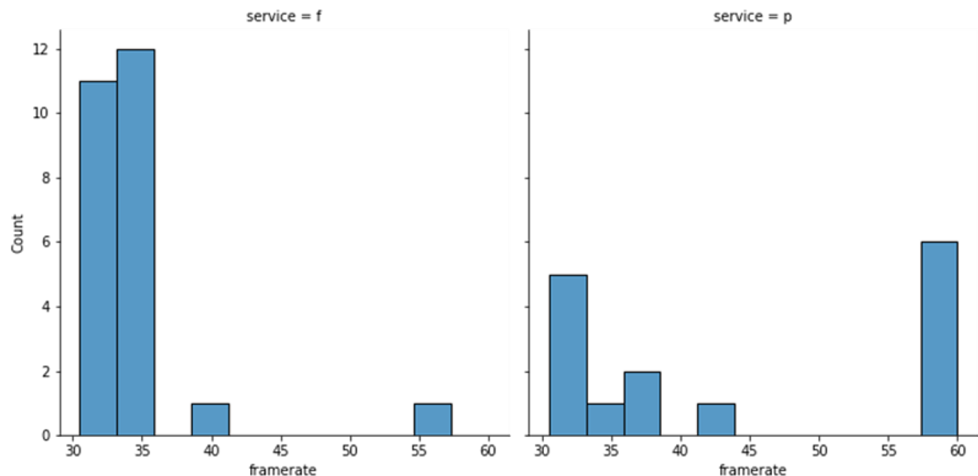
Static measurements



Parallel measurements in a moving train

C198, Rohde & Schwarz – Measuring Quality Influencing Factors of Virtual Reality Services (2)

- Factors measured
→ latency, video bitrate, framerate, jerkiness
- Issue
→ details on how to compute different quality influence factors difficult to retrieve from service (e.g., aggregate delay vs. individual components)
- Proposed action
→ develop detailed guidelines on how to measure individual quality influence factors for VR/XR services



C199, First draft of P.IXC "Interactive test methods for subjective assessment of extended reality communications"

- Scope: define subjective test methods for XR communication
- Aspects addressed
 - Characterization of systems under test, sources, test conditions
 - Control and characterization of test context and subjects
 - Definition of test procedure, tasks, QoE measures, data analysis
- Communication tasks
 - 4 different tasks recommended provisionally
 - Task description
 - Factors to be measured
 - Suggested questionnaires
- Next steps
 - Cross lab subjective studies using different systems, recommended tasks, and methods
 - Next meeting → Sep. 2024
 - Final recommendation



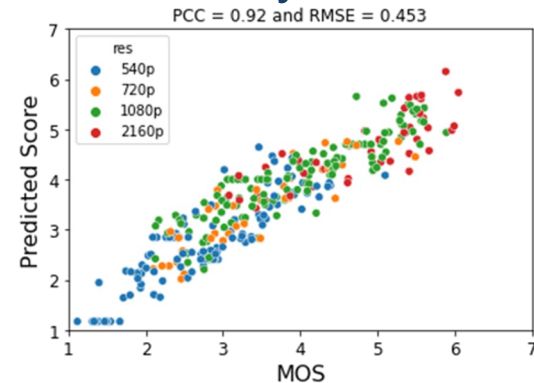
Selected Details

Instrumental Quality Assessment

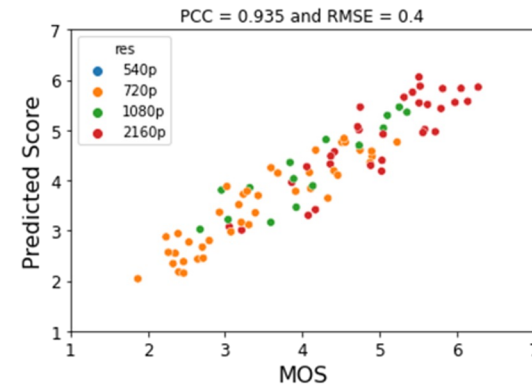


C228, Candidate Model for P.BBQCG - Passive Video Quality

- Candidate model → Retrained ITU-T Rec. P.1204.3
 - Extending ITU-T Rec. P.1204.3 to predict MOS on [1, 7] scale
- Dataset
 - 9 subjective tests
 - 3 tests 1080p/120fps
 - 6 tests 2160p/60fps
 - Three codecs → H.264, H.265, AV1
 - 12 SRCs
 - 900 PVSSs
- Model development
 - H.264 + H.265 → Full model used
 - AV1 → only “Core Model” used
- Performance numbers → 50:50 train:validation split; no source repetition
- Validation test design ongoing



H.264 and H.265

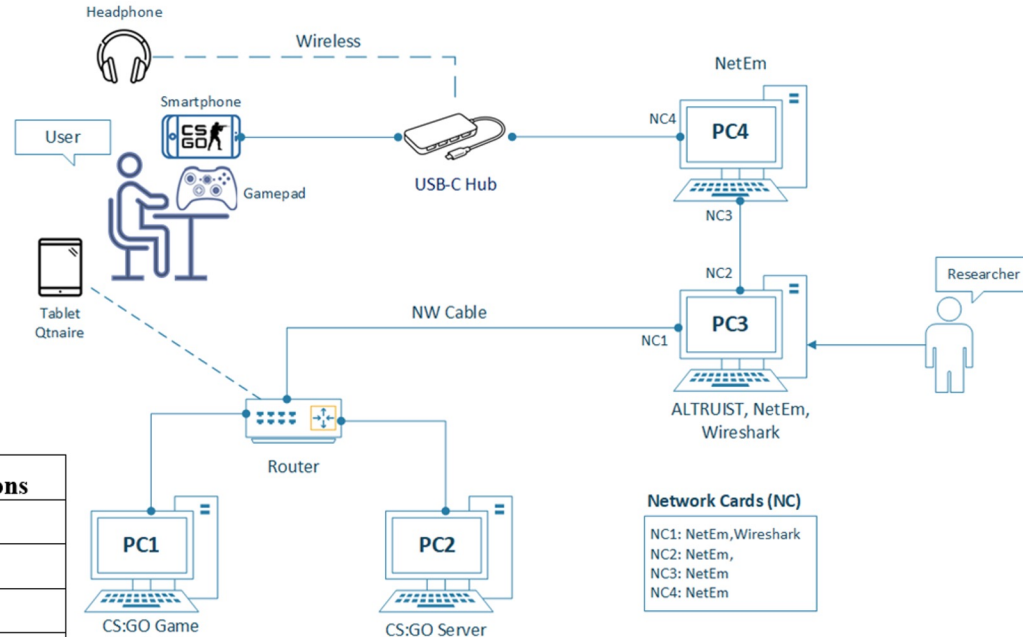


AV1

C194, Validation Results of an User Interactivity Model for Cloud Gaming Over Mobile Networks (1)

- Validation of NLSgMux model
- Subjective test
 - 21 subjects
 - 7 questions: overall QoE, video/audio quality, two controllability quality and two service quality questions
- Used game: Counter- Strike Global Offensive (CS:GO)
- Test conditions see table

Network metric	No. new conditions	No. anchor conditions
RTT	3	2
Combinations (PL, RTT)	6	4
Random Jitter (RJ)	0	1
Spiky Jitter (SJ)	2	1
Combinations (RTT, PL, RJ, SJ)	3	0
Total	14	8



C194, Validation Results of an User Interactivity Model for Cloud Gaming Over Mobile Networks (2)

Model

$$UxIntActQS_{QoE}(rtt, pl, stdev_{rj}, spikesizes_j) = 1 + 4 * k_{scoreoffset} * UxIntActQS(rtt, pl, stdev_{rj}, spikesize_{sj})$$

$$UxIntActQS(rtt, pl, stdev_{rj}, spikesize_{sj}) = F_{RTT}(rtt) * F_{PL}(pl, rtt) * F_{RJ}(stdev_{rj}) * F_{SJ}(spikesize_{sj})$$

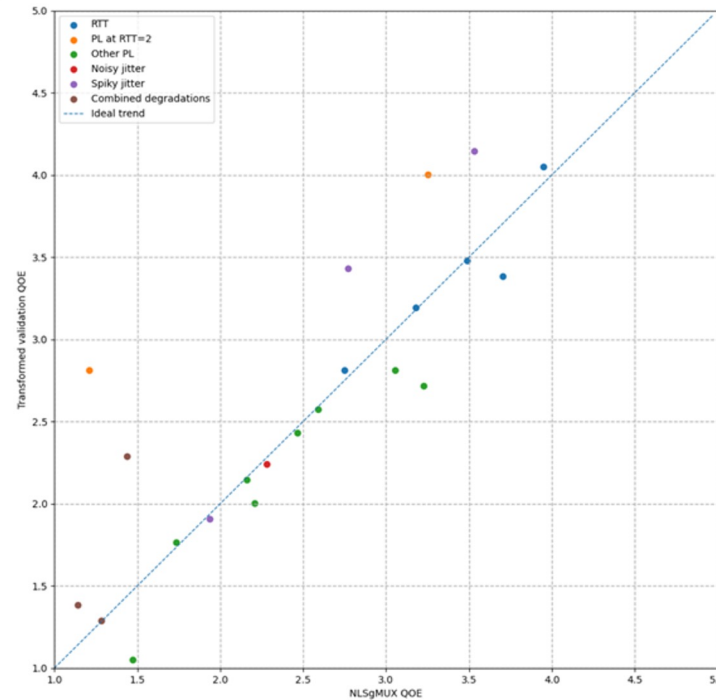
$$F_{RTT}(rtt) = \frac{1}{1 + \left(\frac{rtt}{c_{rtt}}\right)^{b_{rtt}}}$$

$$F_{PL}(pl, rtt) = \frac{1}{1 + \left(\frac{x}{a_{c_{pl}} + \frac{b_{c_{pl}}}{\frac{rtt}{c_{rtt}}}}\right)^{\left(a_{b_{pl}} + \frac{b_{b_{pl}}}{\frac{rtt}{c_{rtt}}}}\right)^{\frac{2}{c_{b_{pl}}}}}$$

$$F_{RJ}(stdev_{rj}) = d_{rj} + \frac{1 - d_{rj}}{1 + \left(\frac{x}{c_{rj}}\right)^{b_{rj}}}$$

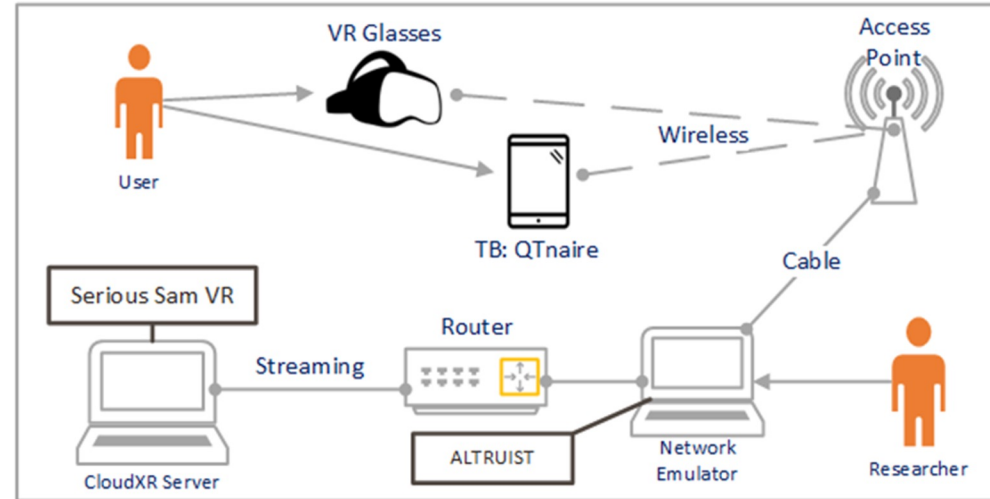
$$F_{SJ}(spikesize_{sj}) = \frac{1}{1 + \left(\frac{spikesize_{sj}}{c_{sj}}\right)^{b_{sj}}}$$

Correlation	0.848
RMSE	0.495
MAE	0.308
Mean error	0.140
AE < 0.25 MOS	63.6%
AE < 1.0 MOS	95.5%



C200, Preliminary Results of an User Interactivity Model for Cloud Gaming Over Mobile Networks for VR use case (1)

- User interactivity model on VR cloud gaming over mobile networks
 - Based on the interactivity model for cloud gaming (C18, C78)
- Test conditions
 - 3 different parameters
 - RTT, PL, RJ
- Used game: Serious Sam VR: The Last Hope

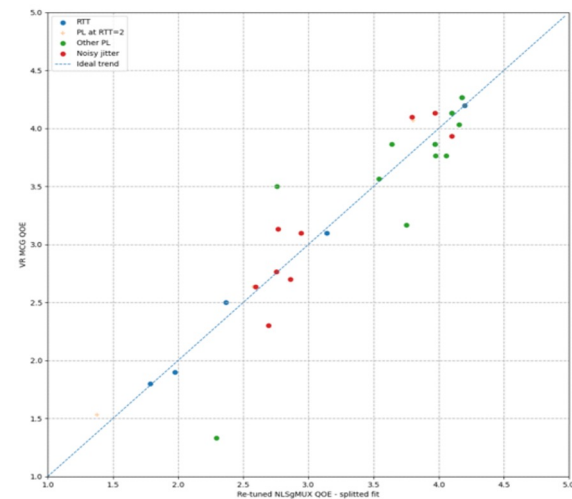


Parameter	No. of conditions	Values
RTT	8	2,25,50,75,175,275,350,400 ms
RTT and PL	11	RTT(2, 25,50,75)ms and PL(2,4,6, 12, 24)%
Mean RTT and RJ	9	Mean RTT(25,50,75)ms and std(1,3,6)

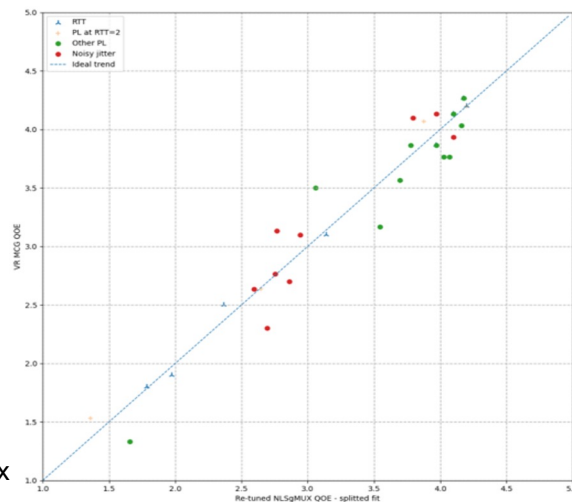
C200, Preliminary Results of an User Interactivity Model for Cloud Gaming Over Mobile Networks for VR use case (2)

- Subjective test
 - 90s gameplay; 90min total test duration
 - 30 subjects
 - Video/audio quality, overall QoE, controllability → [1,5] scale
 - Willingness to continue to play → Yes/No
 - Cybersickness
→ [Nausea, Fatigue, Dizziness, None, Other]
- Considered model → NLSgMux
 - Works well for RTT conditions
 - Redesign of the model → PL conditions
- Next step: validation dataset creation and validation of the model

Re-tuned NLSgMux

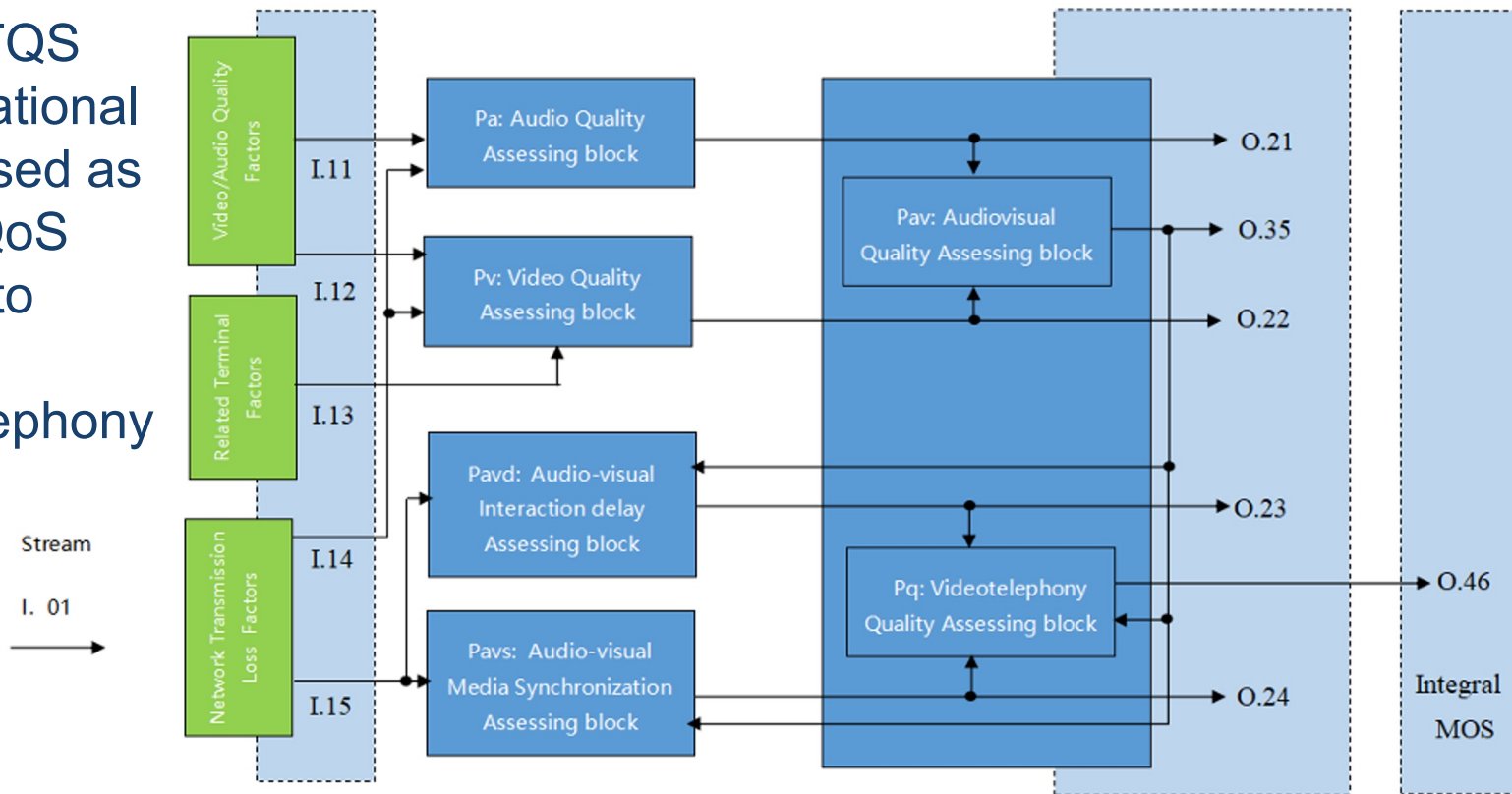


Re-designed NLSgMux



G.CMVTQS

Computational model used as a QoE/QoS monitor to assess videotelephony services



G.CMVTQS – Computational model used as a QoE/QoS monitor to assess videotelephony services

- G.CMVTQS is planned to be completed in an online meeting on 27 August 2024 and presented for consent in WP2/12 (online) on 29 August
- Between now and end of August, G.CMVTQS active parties meet bi-weekly, contact Martin Adolph (Martin.adolph@itu.int) if you want to join
- More information about the work item: https://www.itu.int/ITU-T/workprog/wp_item.aspx?isn=17785



Miscellaneous

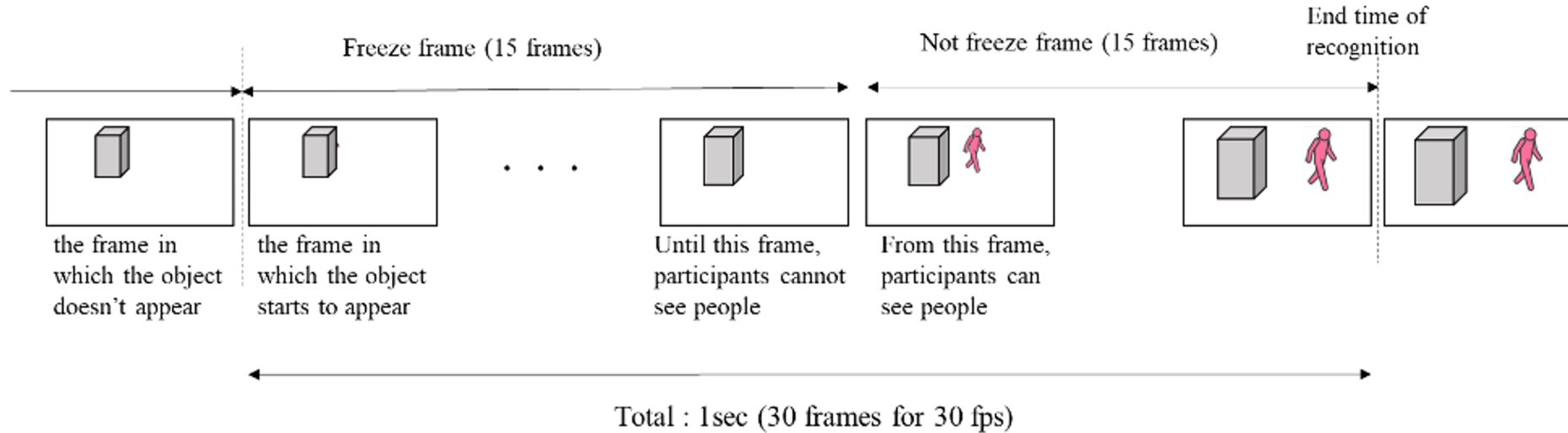


Other contributions and ongoing work

- Reliability of No-Reference Video Quality Assessment Methods in the Development of J.noref
 - Q19/12 Interim Meeting for J.noref test plan at current VQEG meeting (4-5 July 2024)
- Codec extension P.1204.X models (Q14/12)
 - Extensions of P.1204.3 for AV1, VVC (ongoing)
- Pq streaming quality integration module development: P.1203.3 replacement
 - Test plan underway
- P.BBQCG project status and time plan (Q14/12)
 - Validation of the candidate model for passive video quality
 - Interactive tests
- Second draft of the technical report PSTR-OQMXR (Q14/12)
 - Call for participants



Object recognition - C0203, C0204, C0205 (NTT, Japan)



Object recognition - C0203, C0204, C0205 (NTT, Japan)



0.5 seconds after jumping (at 30km/h)



1 second after jumping (at 30km/h)



0.5 seconds after jumping (at 10km/h)



1 second after jumping (at 10km/h)

Proposals in document

- Model should be proposed, and performance results of training model should be shown at next interim meeting (VQEG, July 2024)
- Validation results will be shown in January 2025 (e.g., SG12 meeting).
- Initial draft recommendation presented in June 2025 (e.g., Q19 interim meeting).
- Drafting recommendation finalized in October 2025 (e.g., SG12 meeting).

ITU-T SG12 Contributions April 2024

Videoconferencing

- [\[208 \]](#), Base text for P.UXV: User Experience of multimedia in videotelephony and videoconferencing services, [China Mobile Communications Co. Ltd.](#), [Orange \(France\)](#), [Q10/12](#)
- [\[207 \]](#), Base text for G.CMVTQS: Computational model used as a QoE/QoS monitor to assess videotelephony services, [China Mobile Communications Co. Ltd.](#), [Orange \(France\)](#), [Wuhan University \(China\)](#), [Q15/12](#)
- [\[206 \]](#) G.CMVTQS: Updated test protocol of subjective tests, [China Mobile Communications Co. Ltd.](#), [Orange \(France\)](#), [Wuhan University \(China\)](#), [Q15/12](#)

Gaming, P.BBQCG

- [\[230 \]](#) P.BBQCG project status and time plan, [Telefon AB - LM Ericsson \(Sweden\)](#), [Q14/12](#)
- [\[228 \]](#) Candidate Model for P.BBQCG: Passive Video Quality, [Ilmenau University of Technology \(TU Ilmenau\) \(Germany\)](#), [Telefon AB - LM Ericsson \(Sweden\)](#), [Q14/12](#)
- [\[200 \]](#) Preliminary Results of an User Interactivity Model for Cloud Gaming Over Mobile Networks for VR use case, [InfoVista SAS \(France\)](#), [Q14/12](#)
- [\[194 \]](#), Validation Results of an User Interactivity Model for Cloud Gaming Over Mobile Networks, [InfoVista SAS \(France\)](#), [Q14/12](#)



Contributions - XR: subjective, general considerations

- [\[241 \]](#) Information about standardization work of relevance for assessment of XR meetings, updated March 2024, [Centrum Wiskunde & Informatica \(Netherlands \(Kingdom of the\)\)](#), [Nokia Corporation \(Finland\)](#), [Telefon AB - LM Ericsson \(Sweden\)](#), [Q10/12](#)
- [\[234 \]](#) New work item for studying QoS and QoE standards related to the metaverse, [Brazil](#), [Q2/12](#)
- [\[226 \]](#) ITU-T P.IntVR: "Subjective Test Method for Interactive Virtual Reality Applications" - Completed with Terms, Abbreviations and Bibliography, [Technische Universität Berlin \(TU Berlin\) \(Germany\)](#), [Q7/12](#)
- [\[214 \]](#) Proposed new work item on "Quality evaluation framework of extended reality terminal", [China Telecommunications Corporation](#), [Guangdong OPPO Mobile Telecommunications Corp., Ltd. \(China\)](#), [Ministry of Industry and Information Technology \(MIIT\) \(China\)](#), [Vivo Mobile Communication Co., Ltd. \(China\)](#), [Q10/12](#)
- [\[202 \]](#) Assessing the Impact of LTE and 5G Networks on Virtual Reality Experience, [Türk Telekom A.S. \(Türkiye\)](#), [Q13/12](#)
- [\[199 \]](#) First draft of P.IXC "Interactive test methods for subjective assessment of extended reality communications", [Nokia Corporation \(Finland\)](#), [Blekinge Institute of Technology \(Sweden\)](#), [Centrum Wiskunde & Informatica \(Netherlands \(Kingdom of the\)\)](#), [Ilmenau University of Technology \(TU Ilmenau\) \(Germany\)](#), [Telefon AB - LM Ericsson \(Sweden\)](#), [University of Surrey Institute for Communication Systems\(ICS\) \(United Kingdom\)](#), [Q10/12](#)
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