

MUSHRA Listening Tests

Focusing on Stereo Voice Coding

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Questions Addressed in These Tests

Can Opus compress

- stereo voice in the Silk and the Hybrid mode?
- two simultaneous voices
- binaural content?

How does Opus perform compared to other stereo voice codecs?

- No open source stereo voice codec available
- thus, used AMR-WB+

Measurement Methodology

- Following MUSHRA ITU-R BS.1384-1
- Using software “rateit” version 0.1 with modifications and German translation
- Analysis and summaries using software “rateit.parse”
- Headphones (Sennheiser ABC)
- Sound card: PC Dell DEF
- Participants were not informed about the presence of hidden references

Reference Items

1. One Voice Stereo
8s, stereo voice recording, female German speakers
2. Two Voices Stereo
9s, two stereo female voices mixed together
3. One Voice Binaural
13s, one female voice, rendered with HTRF and added room impulse response, moving
4. Two Voice Binaural
13s, two female voices at different stationary positions, rendered with HTRF and added room impulse response
5. Acappella Song „Mein Fahrrad“ by „Die Prinzen“
10.5s, mono

Degraded Items 1/2

draft-ietf-codec-opus-07/test opus

opus.12k

SILK, 12kbps, stereo, 60ms

Args.: 0 48000 2 12000 -cbr -framesize 60 -bandwidth NB

opus.16k

SILK, 16kbps, stereo, 20ms

Args.: 0 48000 2 16000 -cbr -framesize 20 -bandwidth WB

opus.32k

HYBRID, 32kbps, stereo, 20ms

Args.: 0 48000 2 32000 -cbr -framesize 20 -bandwidth FB

opus.64k

CELT, 64kbps, stereo, 20ms

Args.: 1 48000 2 64000 -cbr -framesize 20 -bandwidth FB

Degraded Items 2/2

AMR-WB+ using 26304 ANSI-C source code v6 6 0

amrwbp.12k 12kbps, 80ms

Args.: -rate 12

amrwbp.16k 15.2kbps, 80ms

Args.: -rate 16

amrwbp.32k 32kbps, 60ms

Args.: -rate 32

Anchor lowpass 3.5k mono

Args.: sox in.wav -r48000 -c1 out.wav lowpass 3500

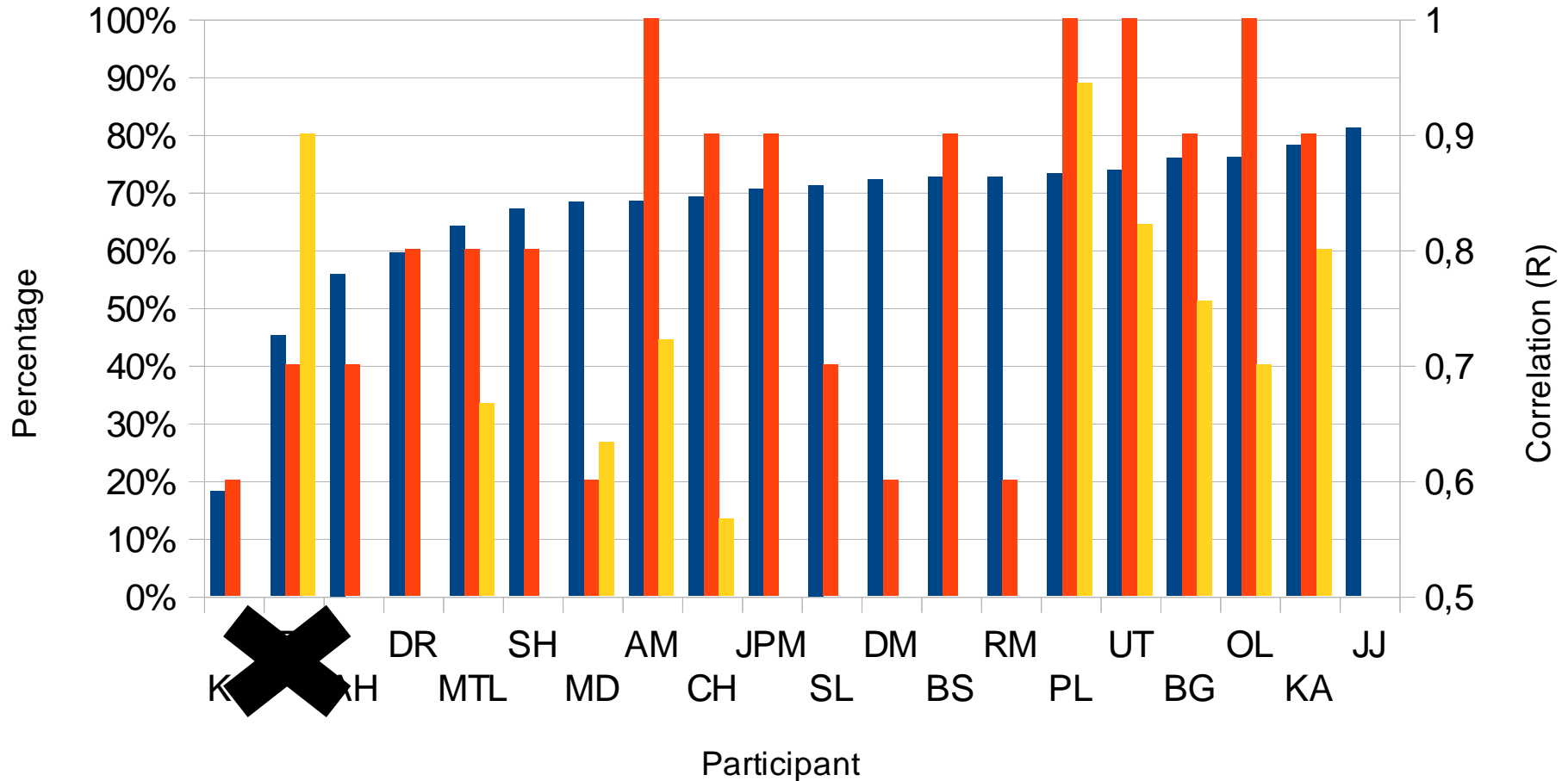
Participants

- 20 German native speakers
- Age: between 20 and 59,
- Avg. Age: 30.55
- 9 male, 11 female
- All have academic backgrounds

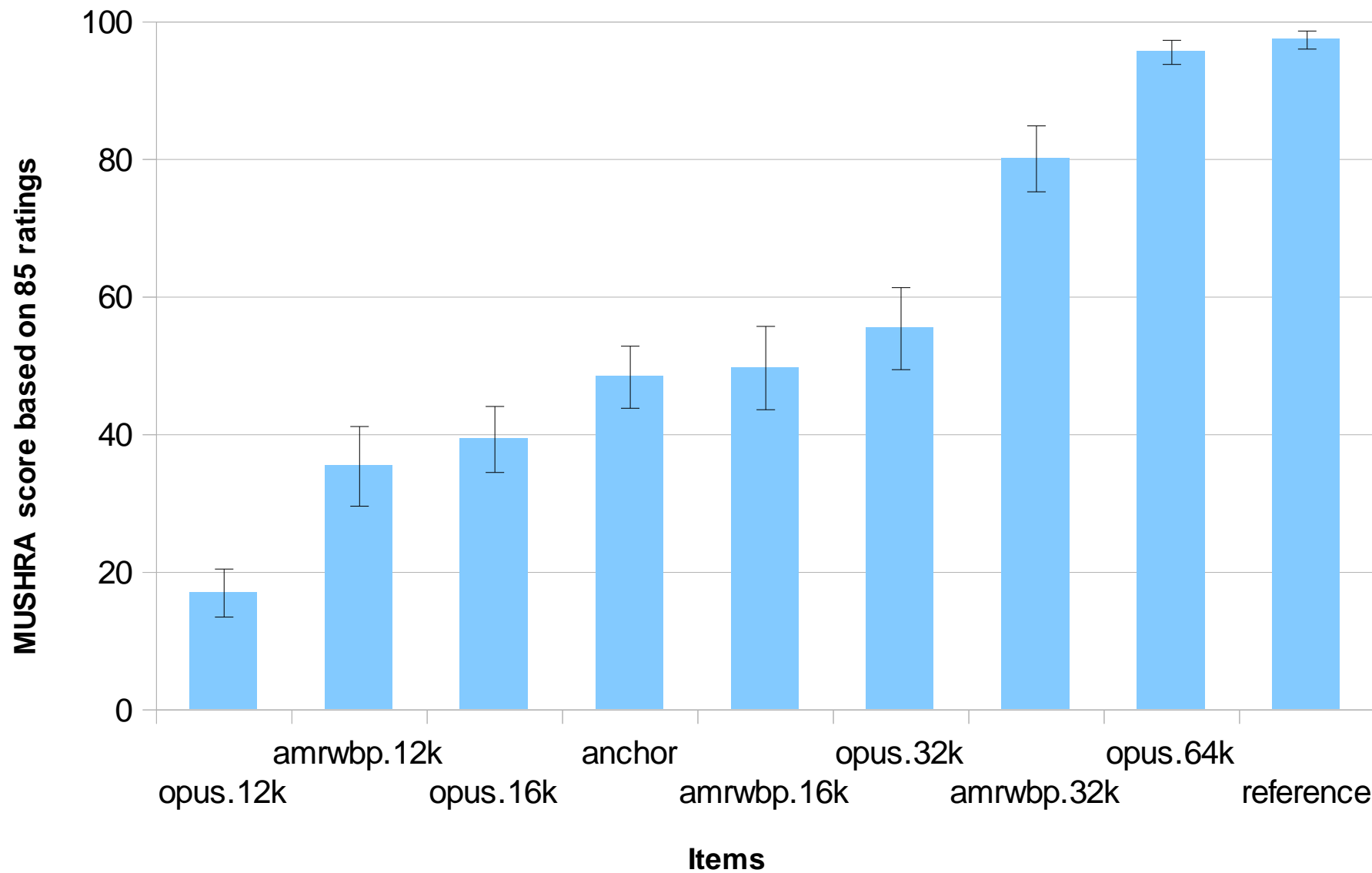
Quality of the individual ratings was verified with

- Correlation (R) between individual ratings and averaged ratings
- If $R \geq 0.8$, individual ratings are good enough.
- The results of three participants were removed.

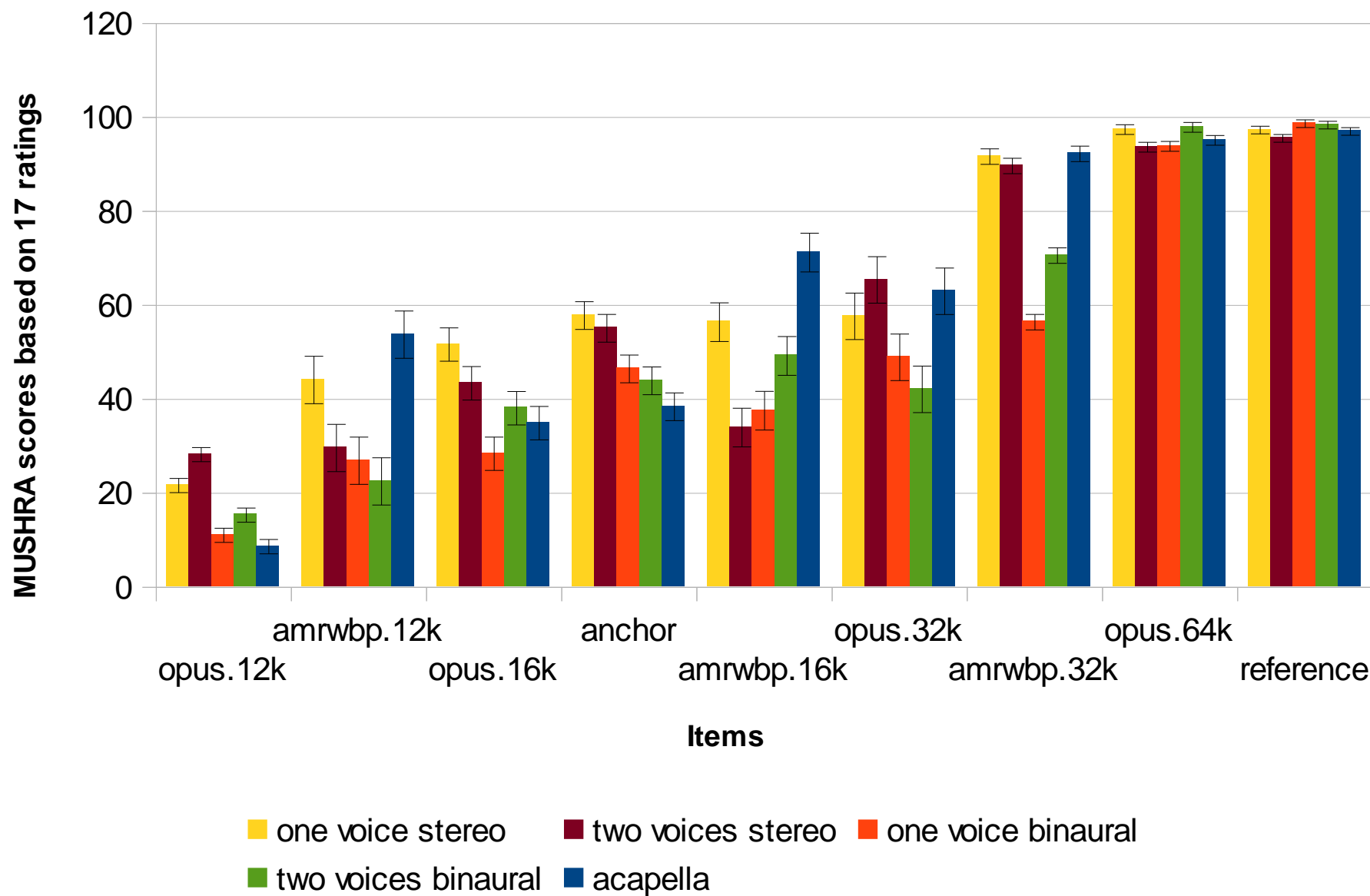
Participants: Different Quality Criteria



Results: Codecs



Codec and Item



Summary

- For stereo voice in wideband quality, Opus needs 16kbps in Silk mode
- Two (or more) voices are compress ok at 32kbps in the hybrid mode
- Binaural contents is only well compressed at 64kbps with CELT
- AMR-WB+ (at 80ms framesize) is better than Silk/Hybrid (at 20ms)
- AMR-WB+ cannot compress binaural content well.