

# Dependency of Subjective Echo Perception on Echo Quality

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**Abstract** – The paper presents new subjective results of talking quality (TQ) dependency on echo quality for defined return loss and echo delay. The purpose is to examine the subjective differences between clear echo, echo with noise and purely noisy (of MNRU type) echo. The results confirm the echo quality affects the subjective perception on a top of return loss and echo delay.

Keywords: Conversational Quality, Echo Return Loss, Echo Delay, Perceived Echo Annoyance

## 1. INTRODUCTION

Talker Echo (TE) is considered as important impairment of contemporary telecommunication networks. Its subjective (perceptual) annoyance can be assessed in repeatable way e.g. acc. to P.800 [1] and the quality parameter directly related to TE is Talking Quality (TQ) [2], and consequently also Conversational Quality (CQ) [2]. Although in the past Listening Quality (LQ) was often considered as a dominant parameter influencing overall telephone conversation quality, TQ and Interaction Quality (IQ) are now taken seriously into account when assessing total call quality.

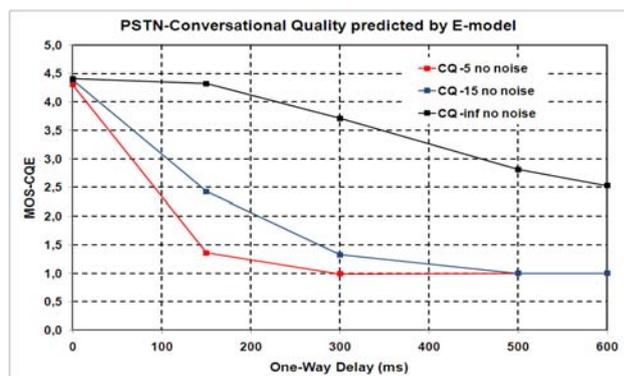


Fig. 1 E-model (G.107) output for 3 different ERL levels (-5dB, -15dB and no echo). Both cases with echo are monotonic.

Even though no objective signal-based model is standardized at the moment, at least parameter-based E-model [3] enables to predict customer opinion on CQ for calls with given TE levels and delays.

Three examples of E-model output (no echo, and echo levels of -5 and -15 dB) are shown in the Fig. 1. One can see that only background noise, echo return loss (ERL)

and echo delay (ED) are considered to be important parameters when analyzing echo subjective annoyance.

## 2. SUBJECTIVE TEST

Another important parameter influencing echo subjective perception, is echo quality, means how “well transmitted” the reflected speech is. To examine this aspect, a network simulator for real-time CQ tests has been developed. The simulator is equipped with unique real-time MNRU block for echo distortion, and the following setups have been prepared:

- Clean echo
- Echo with MNRU 0dB (speech and modulated noise)
- Echo with modulated noise only (no speech)

In all 3 cases, the overall power of the reflected signal was set to ERL=15 dB. The noise used for MNRU was of Hoth type. The echo delay values examined were 100ms, 300ms and 600 ms. All together, more than 100 conversations fulfilling P.805 requirements were run on 24 participants. The simulator is installed in subjective lab where the critical room has 185 ms reverberation time and 10 dB SPL (A) background noise.

## 3. RESULTS

The results are depicted in Fig. 2. It is evident that modulated noise and speech combined with modulated noise are perceived up to 1 MOS point worse than clean speech, even though the level (ERL) and delay (ED) are the same.

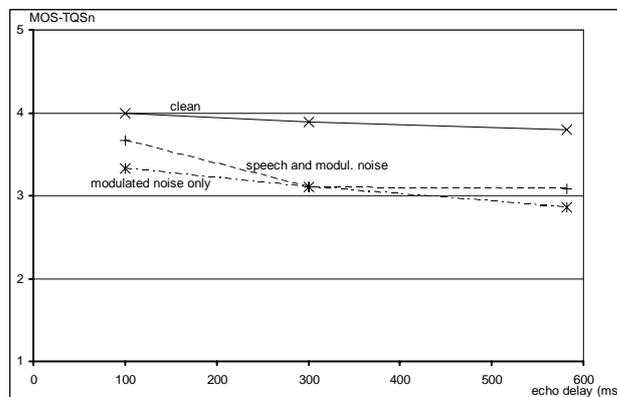


Fig. 2 Subjective test results. ERL = 15dB for all tested cases.

#### 4. CONCLUSIONS

It was demonstrated that subjective perception of echo in noise-free environment depends on echo quality, too. Thus, the widely reported echo parameters ERL and ED do not depict subjective echo perception fully and additional parameter, describing reflected signal quality, would be needed.

#### 5. Acknowledgments

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#### 6. References

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