International Telecommunication Union

ITU-T Study Group 12

Session 6:

Extensions of the E-model

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Workshop on QoS and user-perceived transmission quality in evolving networks
Dakar (Senegal), 18 - 19 October 2001

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E-Model: Present Status

- applicable to network planning of traditional, narrow-band and handset terminated networks
- estimates voice transmission quality mouth-to-ear as perceived at receive side
- renders a transmission factor *R*

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Transmission Rating *R*

$$R = Ro + Is + Id + Ie + A$$

R = transmission rating

Ro = basic signal-to-noise ratio

Is = simultaneous impairment

Id = delayed impairment

Ie = equipment impairment

A = expectation

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Basic Additivity Property of the E-Model

"The model's basic principle is the fact that evaluation of psychological factors (not physical factors) on a psychological scale is additive."

(from OPINE; ITU-T Suppl. 3 to P-series Rec., 1993)

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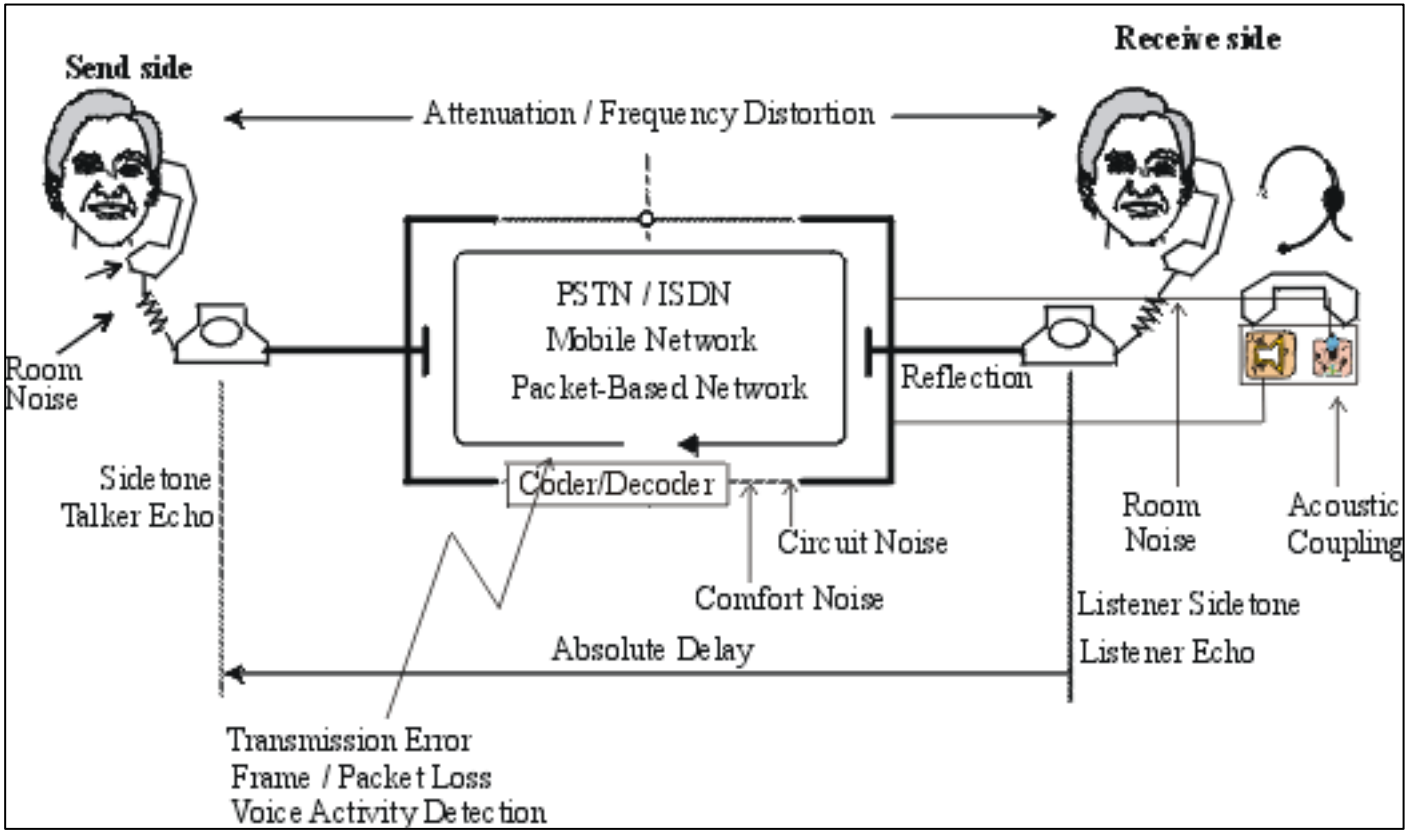
Current and Future E-Model Scenarios



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Short-term Goals

- derivation of *Ie*s for codecs
  - from auditory tests (P.833)
  - from instrumental models
- transmission errors

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Long-Term Goals

- analysis of the additivity principle for *Ie*s
- terminal equipment
- transmission bandwidth
- speech-sound quality
- conversational quality features
- user expectation

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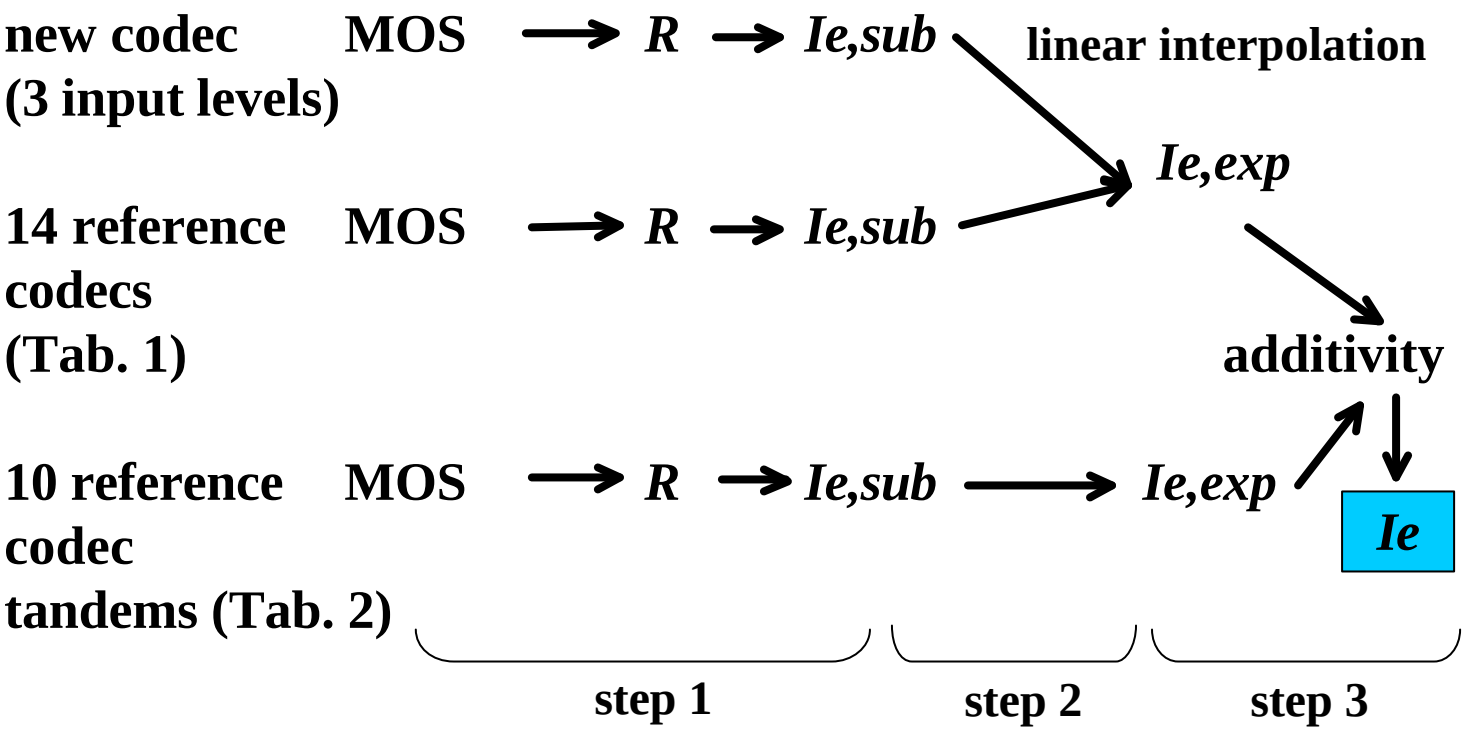
Derivation of *Ie*s from Auditory Tests (P.833)



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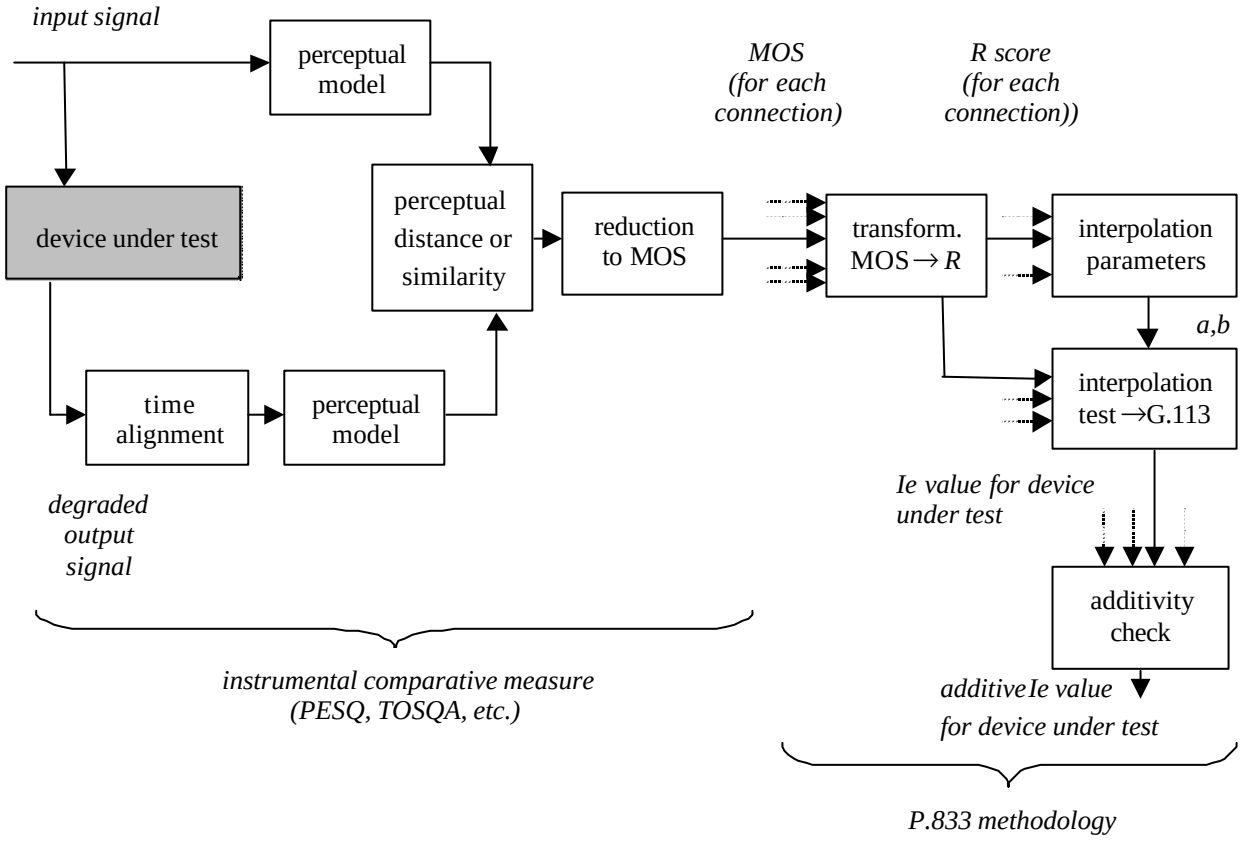
Derivation of *Ie*s from Instrumental Models



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Transmission Errors

- first approach: tabulate *Ie*s for each codec and packet/frame loss condition, incl. potential error concealment (G.113)
- final solution: derivation of formulae taking specific error parameters (frequency, time distribution, burstiness, etc.) as an input (Del. Contr.)

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Acoustic & Expectation-Related Effects of Sound Quality of Terminal Equipment

- specific transmission characteristics terminal -> ear
- basic signal-to-noise ratio *Ro* is no more valid
- no distinction network/terminal
- user expectation: different for handsets, HFTs and headsets

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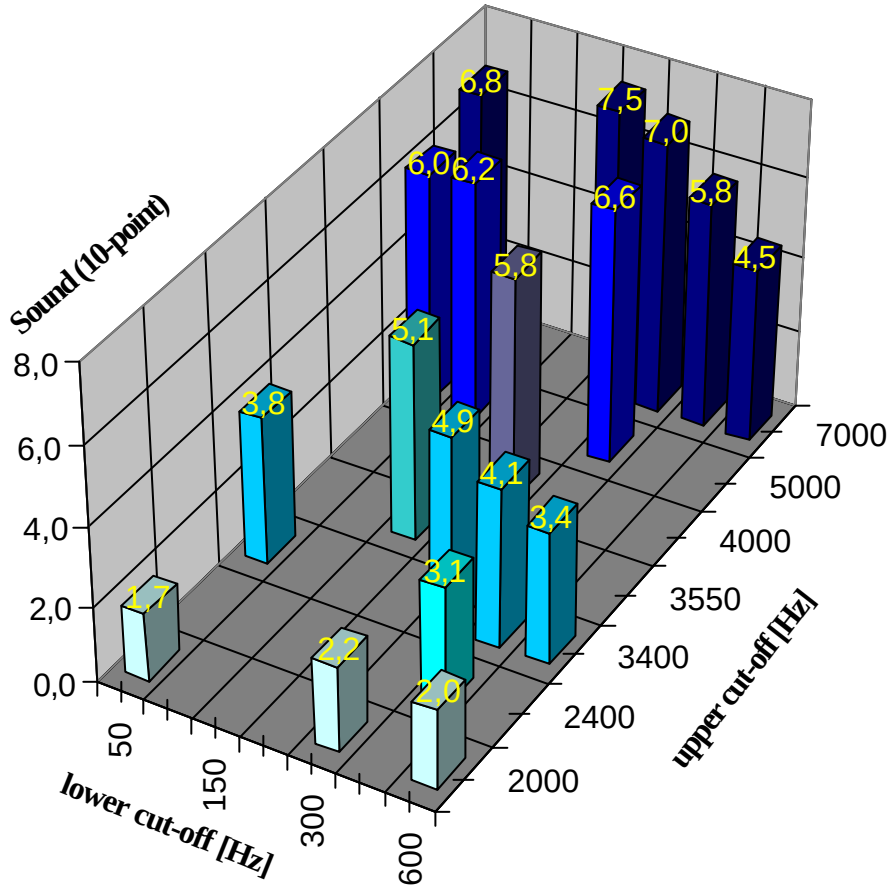
Speech-Sound Quality and Transmission Bandwidth



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Conclusions

- methodologies are available to derive codec *le*s (auditory & instrumental)
- model extensions for transmission errors are currently proposed
- the fundamental assumption of additivity still has to be investigated for non-handset user interfaces, wideband transmission and codec *le*s

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Outlook: Transmission Impact on Speech Technology Devices