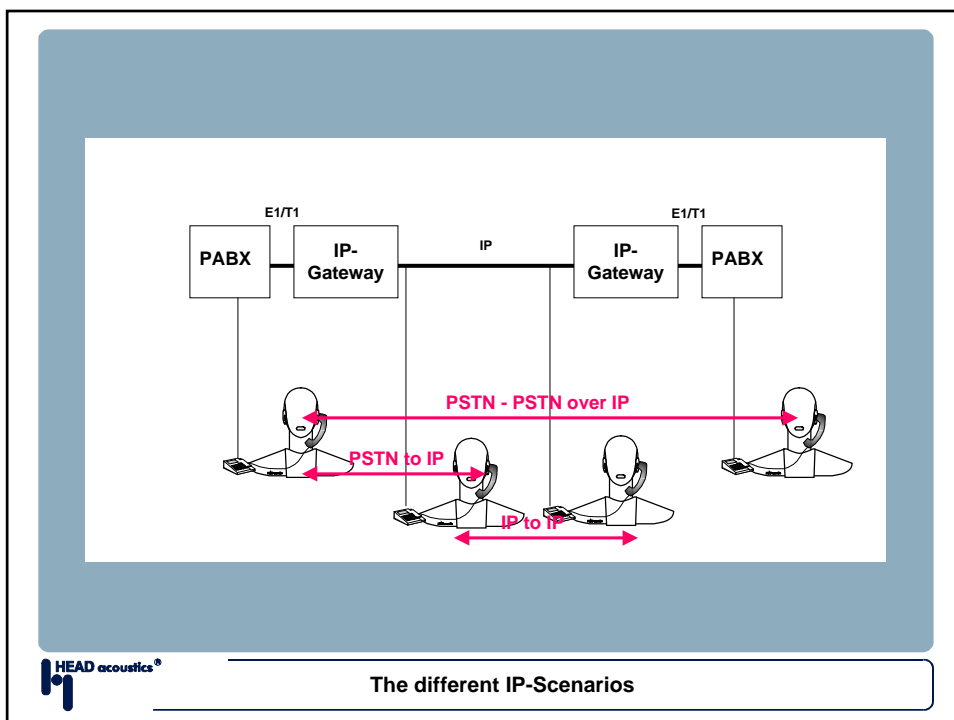
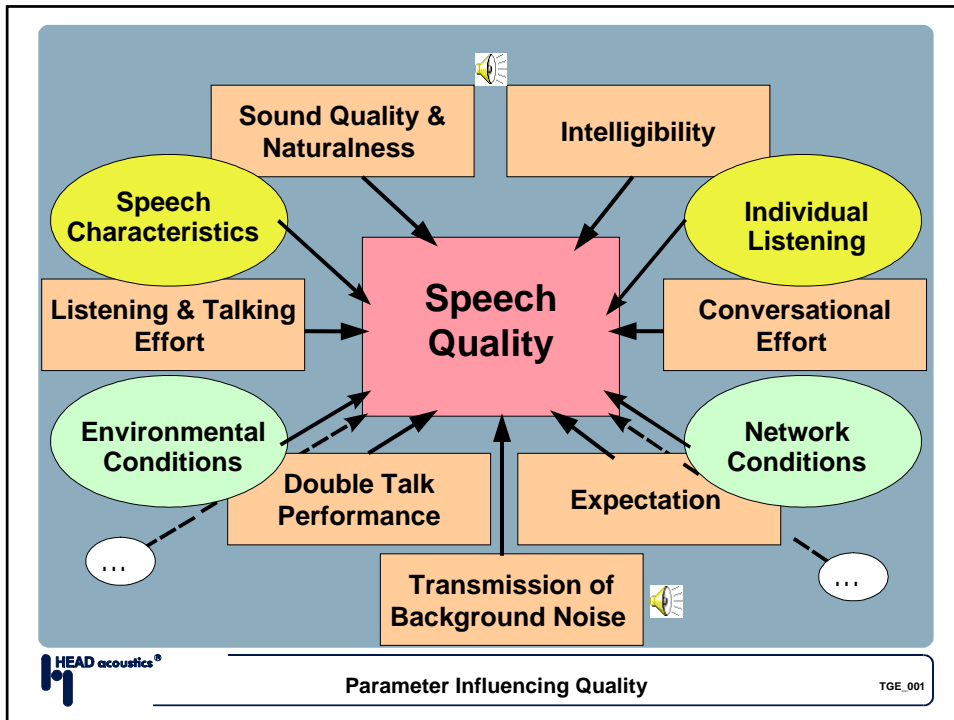
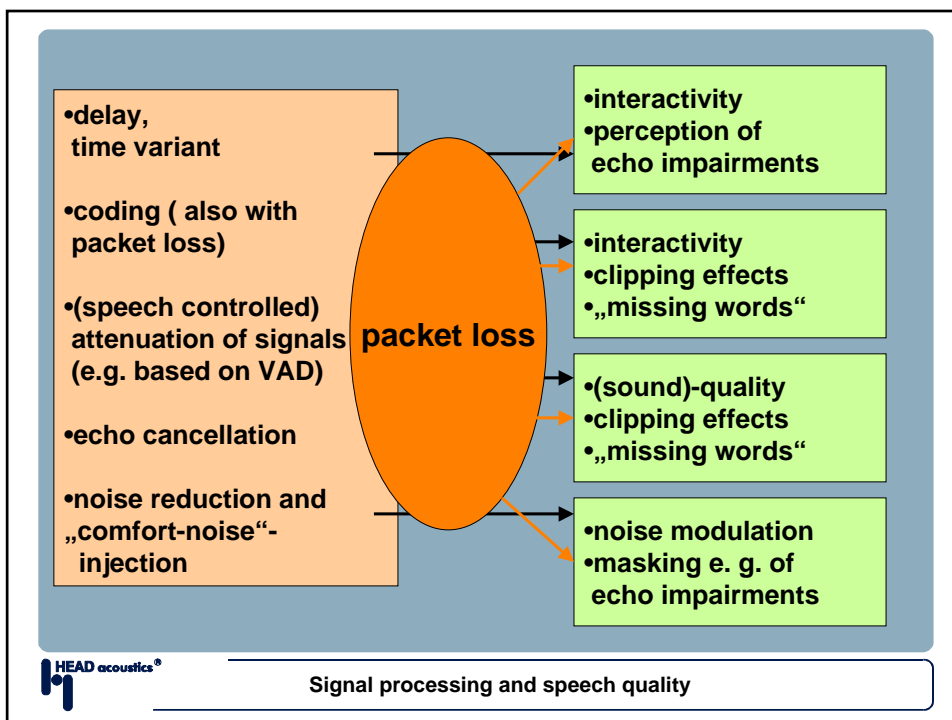
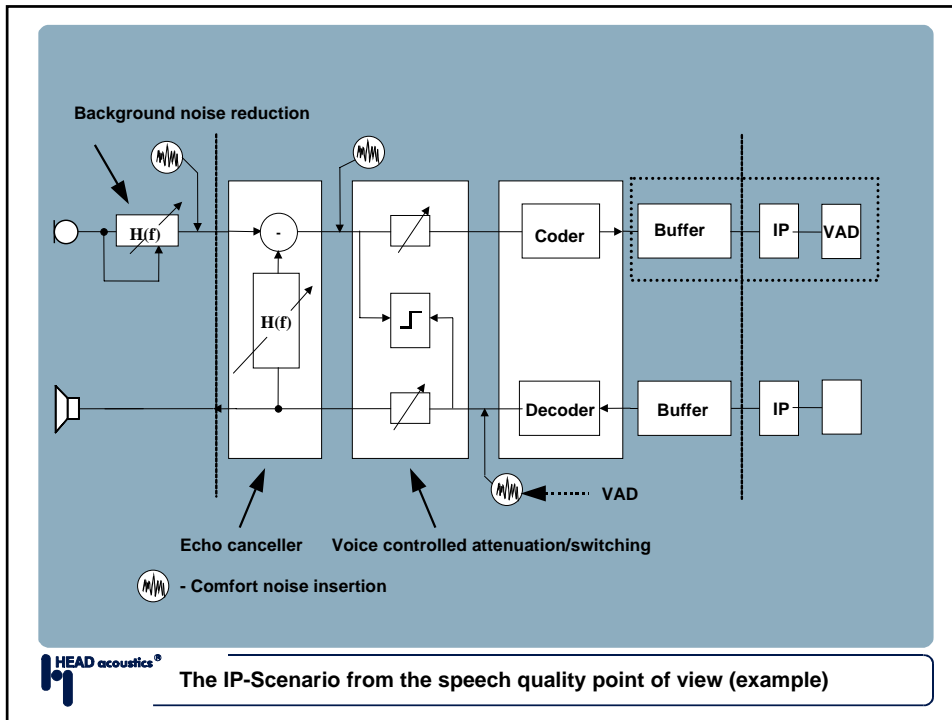


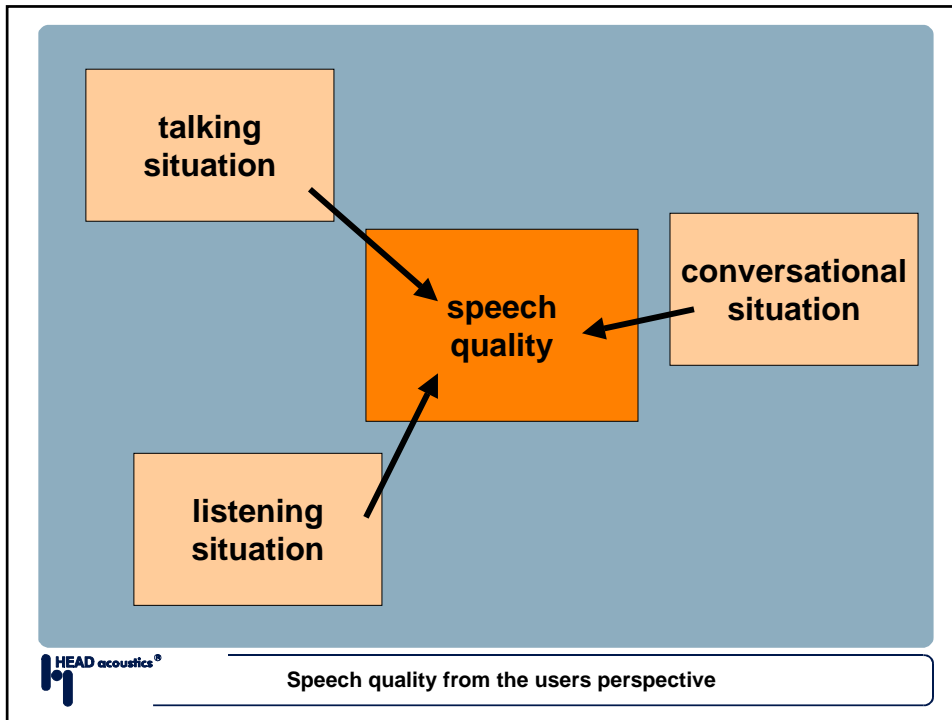
Conversational Speech Quality - The Dominating Parameters in VoIP Systems

**H.W. Gierlich, F. Kettler
HEAD acoustics GmbH**

- **Typical IP-Scenarios:
components and their influence on
speech quality**
- **testing techniques for speech quality
parameters, selected examples**
- **Summary and future work**







| listening situation | talking situation | conversational situation |
|---|--|--|
| <ul style="list-style-type: none"> - "standard"- parameters, e.g. Loudness Ratings - psychoacoustic motivated proced., e.g. PESQ, TOSQA - ext. measurements, e.g. switching characteristics - background noise transmission, e.g. Relative Approach | <ul style="list-style-type: none"> - delay - echo attenuation - echo-/sidetone-distortion - proposals for psychoacoustically motivated tests, e.g. PESQM (perceptual echo and sidetone quality measure) - background noise transmission, e.g. Relative Approach | <ul style="list-style-type: none"> - delay - echo attenuation - echo-/sidetone-distortion - switching characteristics - time variant echo characteristics |

HEAD acoustics® | Relevant quality parameters in the three situations

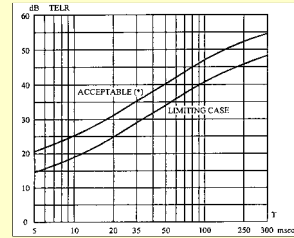
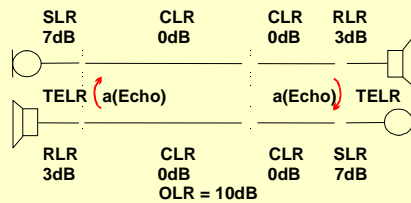


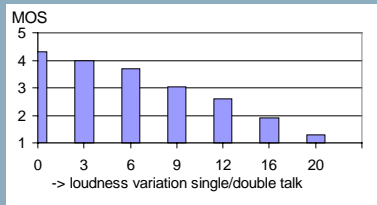
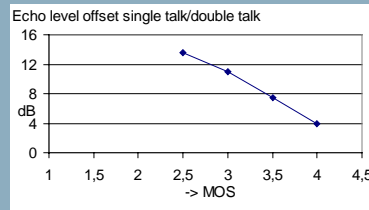
Fig. 1 G.131



Delay and echo attenuation during single talk

TGE_014

**echo during double talk:
the effect of echo level
increase during double
talk on subjects judgement**



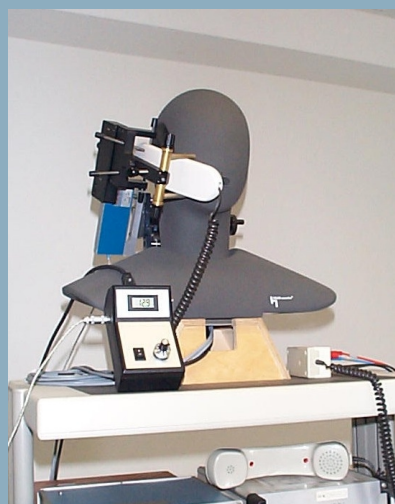
**level variation between
single- and double talk:
the effect on subjects
judgement**



Double talk, important performance limits

Measurement-technique - selected examples:

- **Listening speech quality**
- **Echo & switching during double talk**
- **background noise transmission (Relative Approach)**
- **„comfort-noise“ injection**

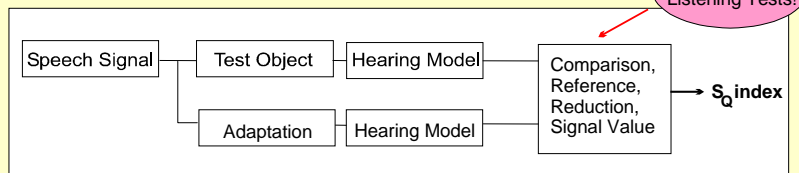


Measurement for handsets and headsets

Instrumental Measures based on Hearing Models:

Modeling the Results of Auditory Tests by Comparison of Reference Speech Signal with Processed Speech Signals

Typical Processing Steps (Schematic):



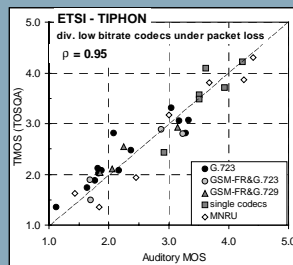
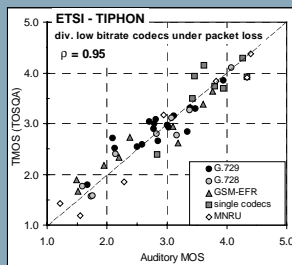
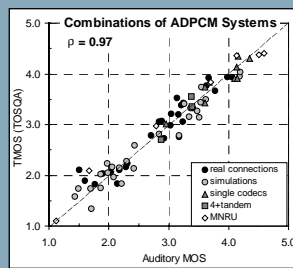
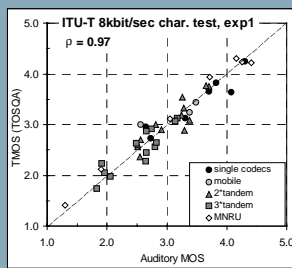
Realizations:

- spectral distance measures
- PESQ (P.862)
- TOSQA
-

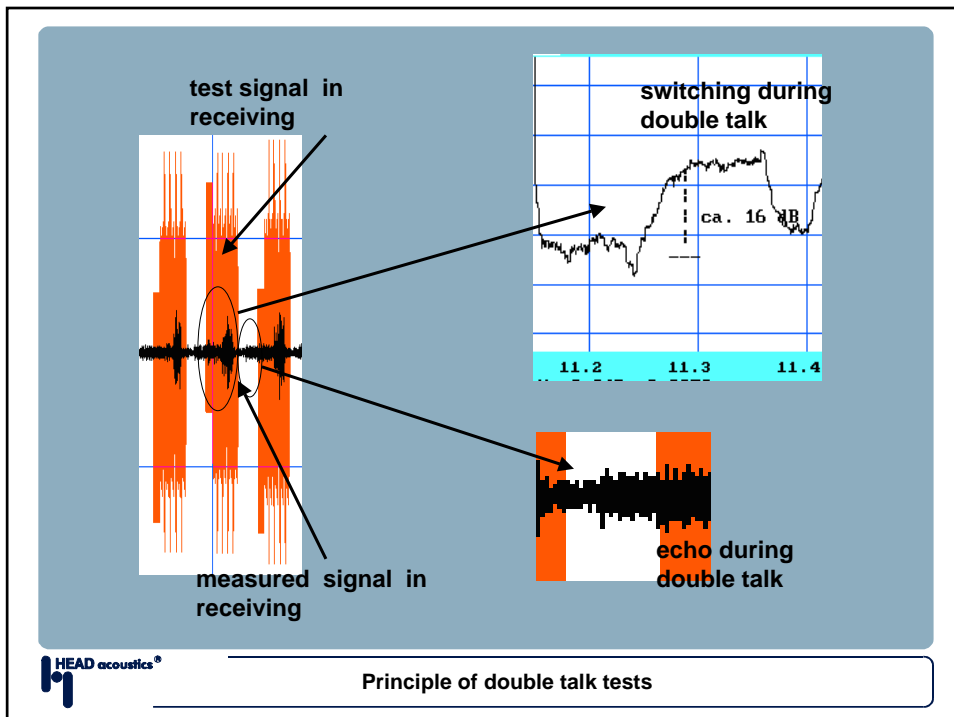
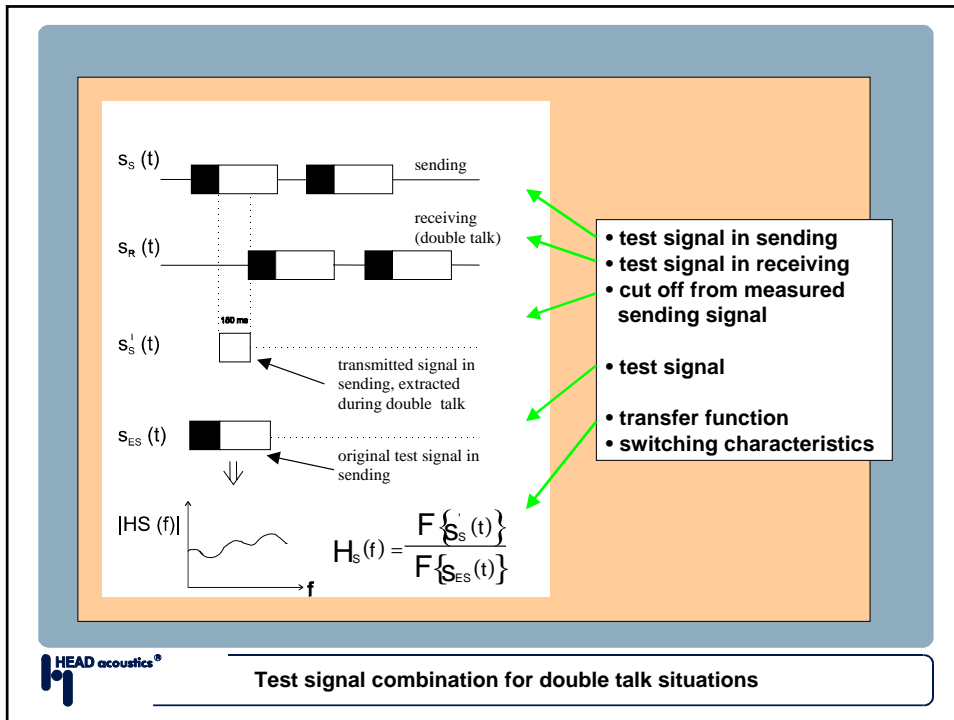


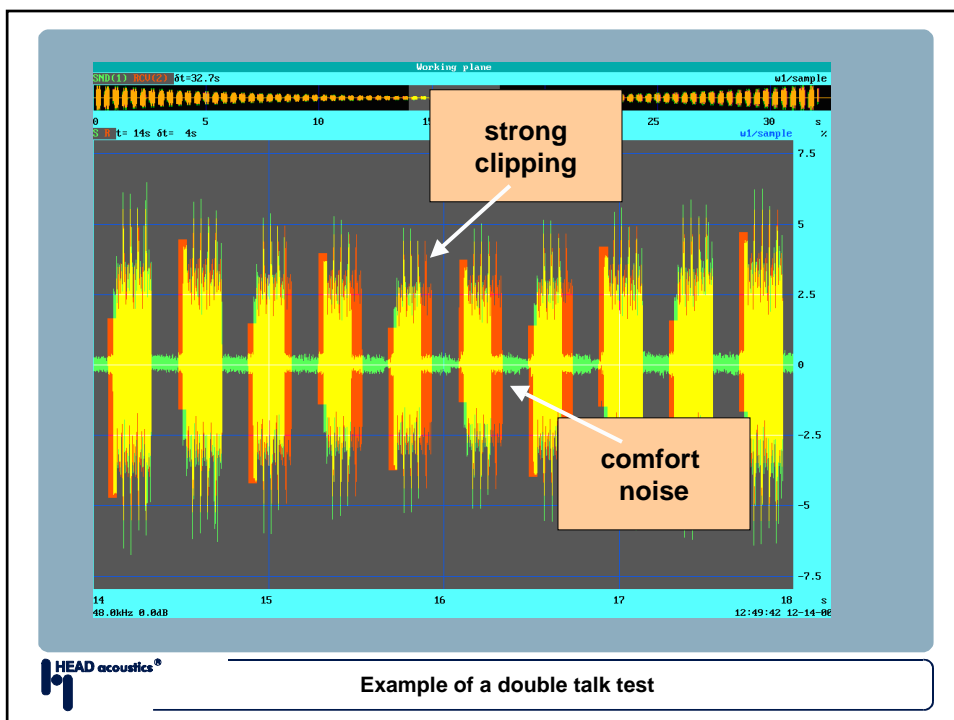
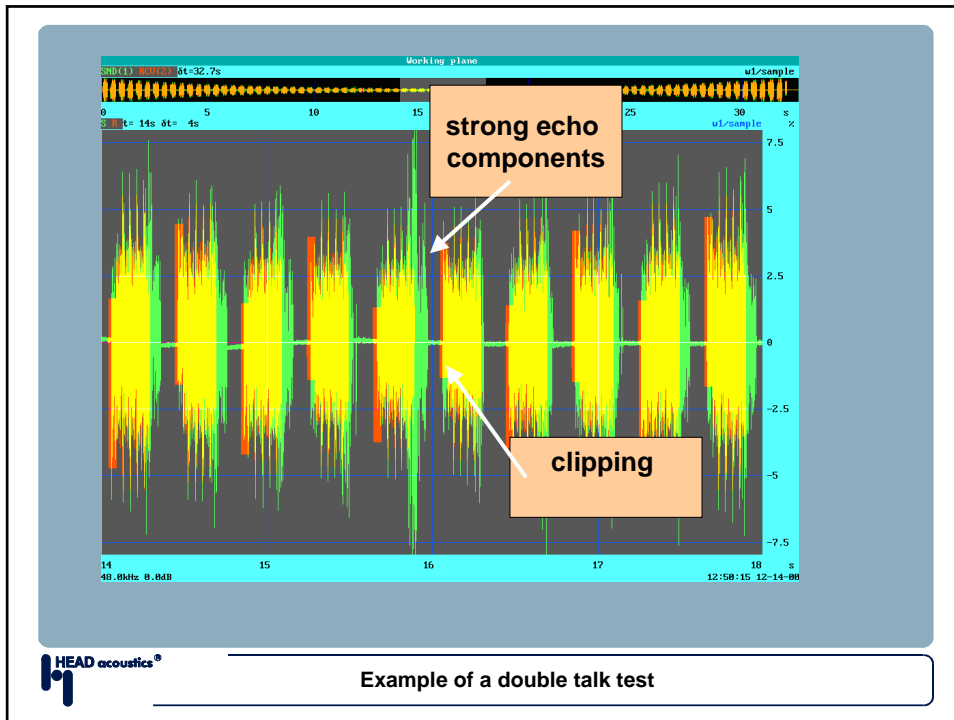
General construction of perceptual models

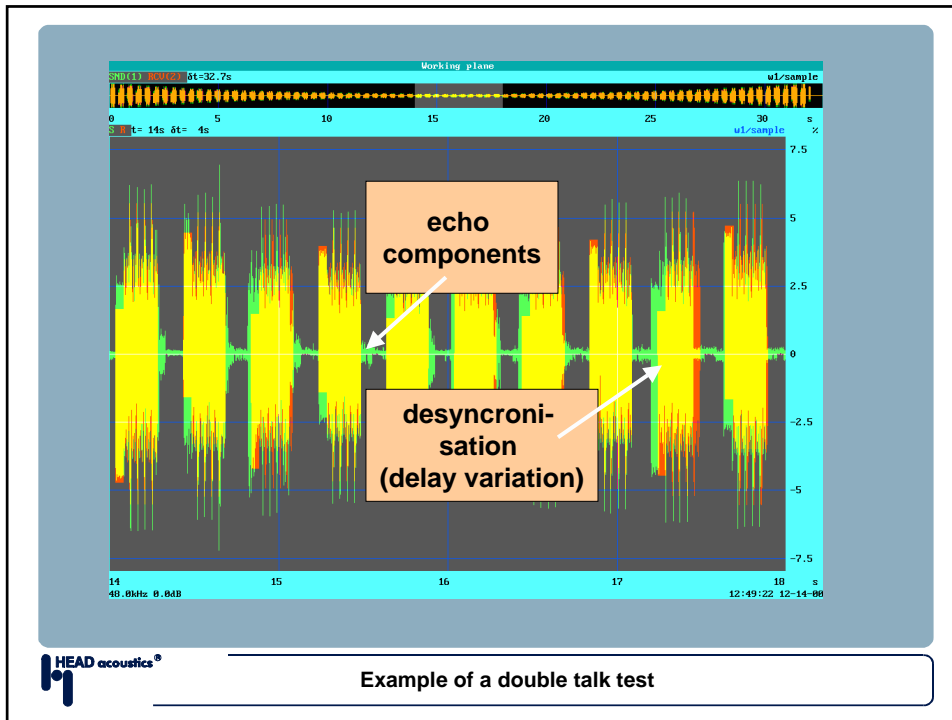
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TOSQA validation, some Results [Berger]



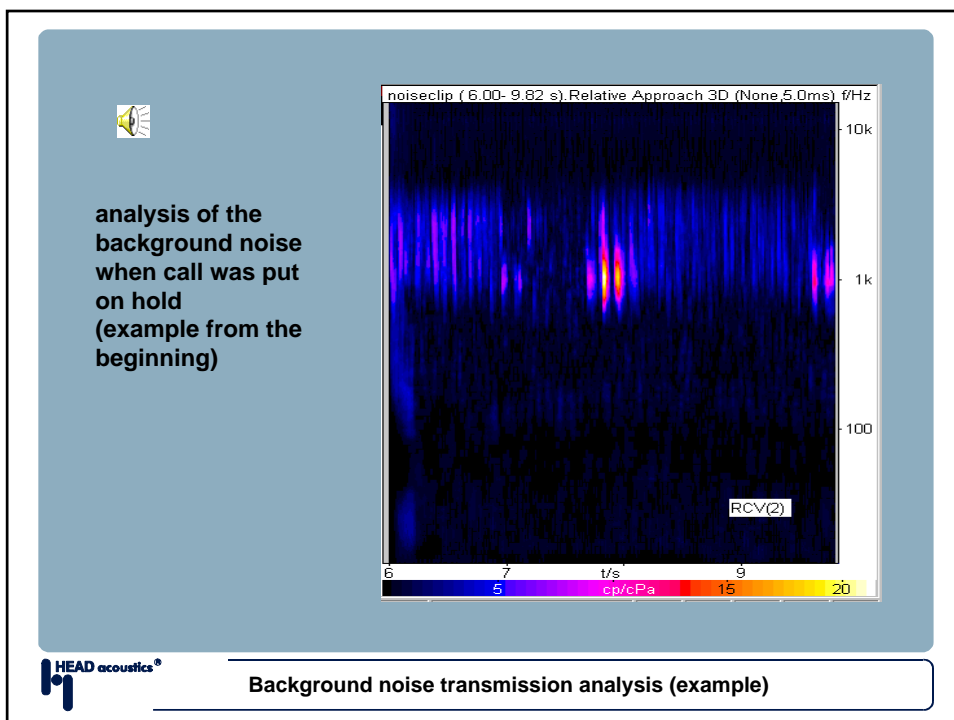
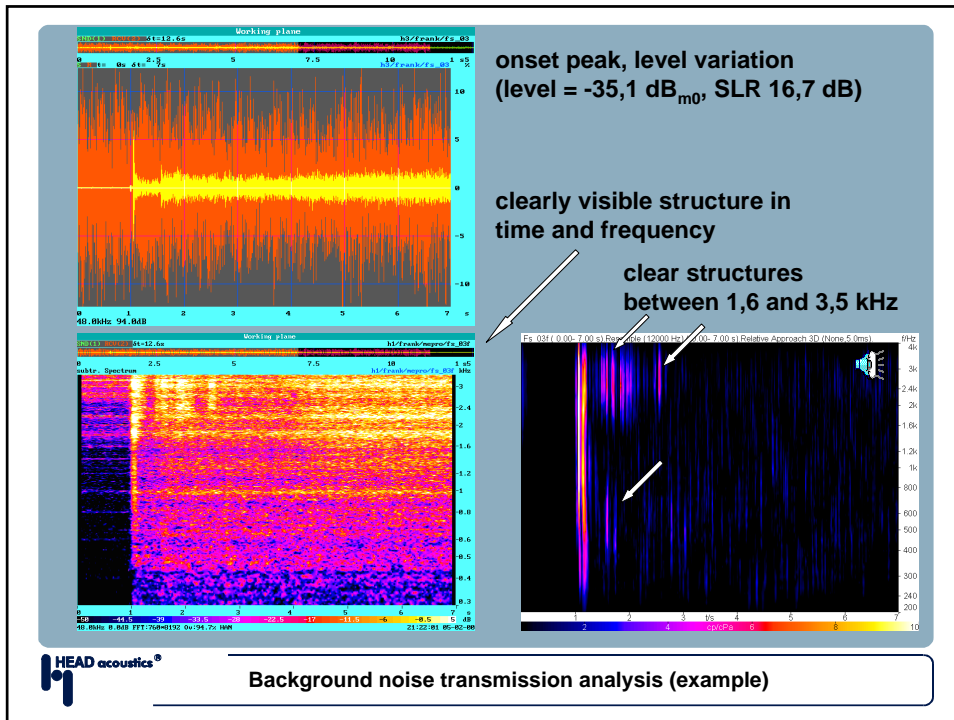


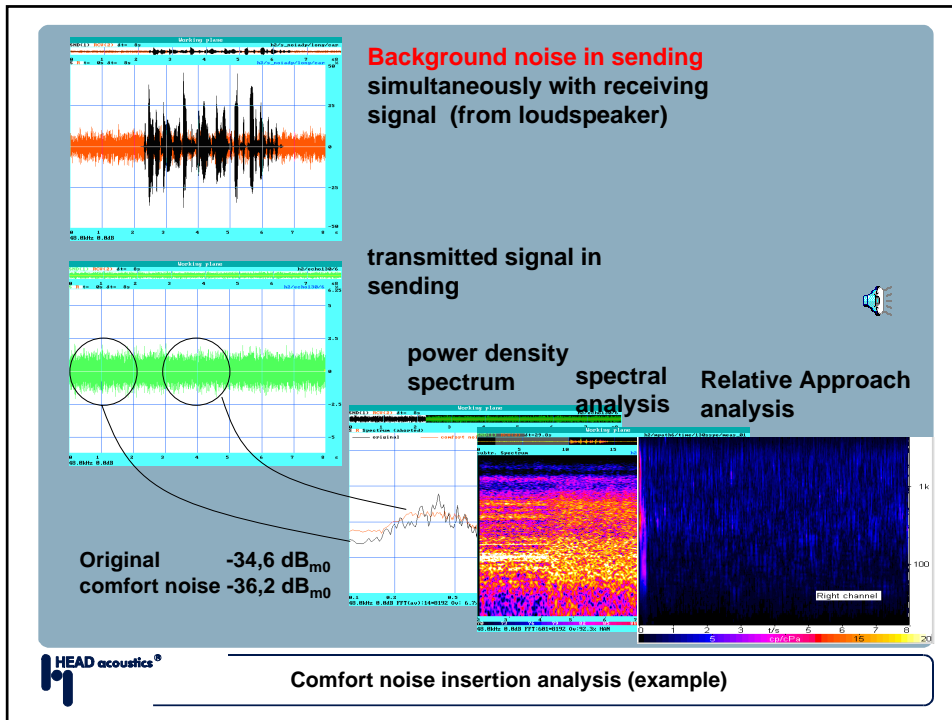


$$Q = f(N,S) + f\left(\sum_{i=1}^{24} \left[\left| F_G(i-1) - F_G(i) \right| \cdot w_1(i, F_G(i)) + \sum_{n=1}^T \left| F_G(i,n) - F_G(i,n+1) \right| \cdot w_2(i, F_G(i)) \right] \right)$$

Basic principle of the Relative Approach:
 Comparison between short term and long term averaging of signal energies in critical bands (app. 2 s vs. 2 ms) based on a hearing model [Sottek]

Background noise transmission: Relative Approach [Genuit]





Summary and outlook:

- Speech quality influenced by
 - * condition and load of the network
 - * interaction of network components
 - * interaction of terminal and network
 - * environmental conditions at the users location
- Test methods available for various parameters
- Further investigations needed on noise transmission
„overall quality“ - number

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Summary