International Telecommunication Union

Background Noise Simulation and Hands-Free Testing in a Car: The ETSI STF 273 Project and Its Impact on Car Hands-Free Testing

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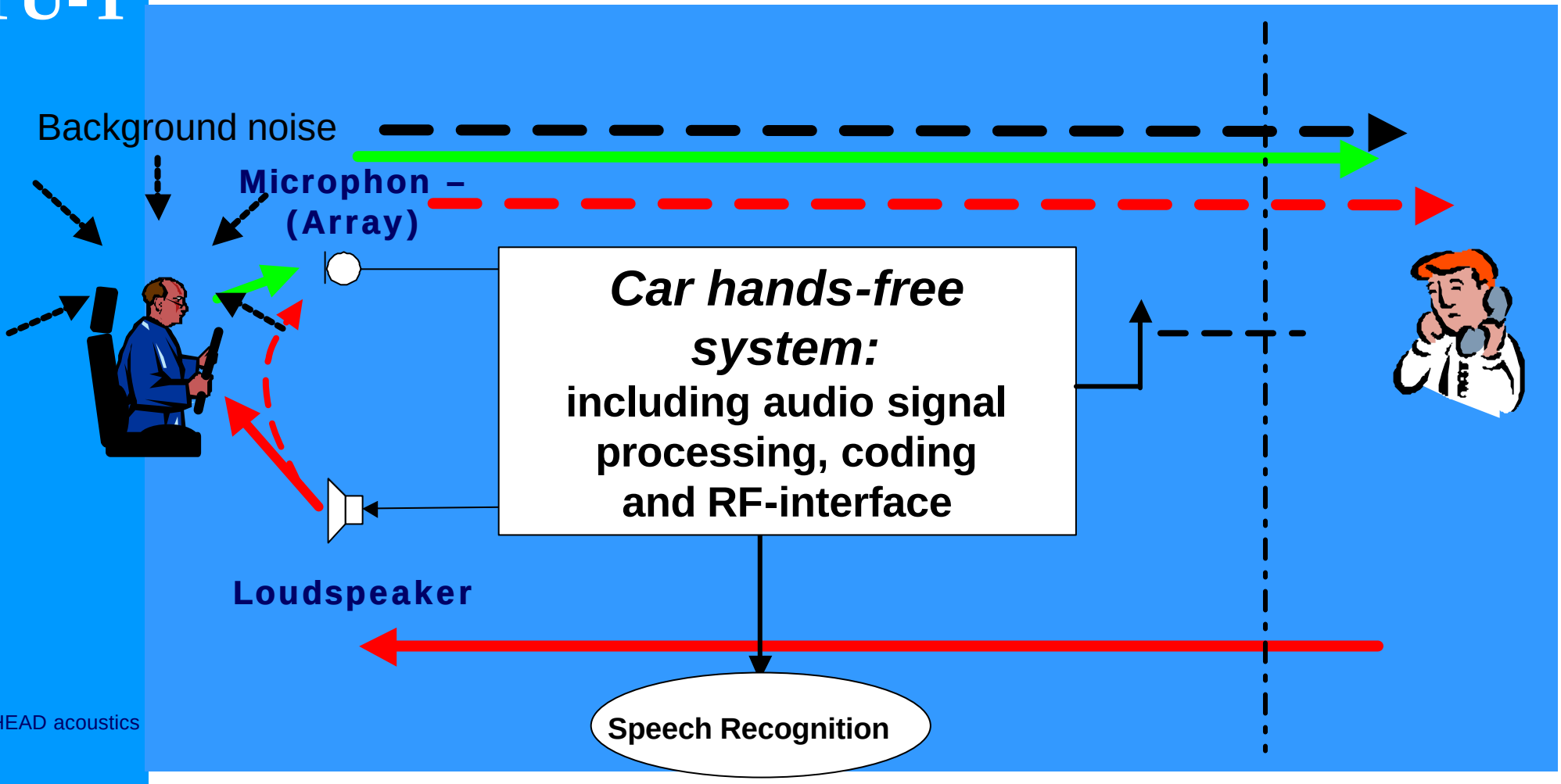
"The Fully Networked Car, A Workshop on ICT in Vehicles"
ITU-T Geneva, 2-4 March 2005

The Car Hands-Free Problem



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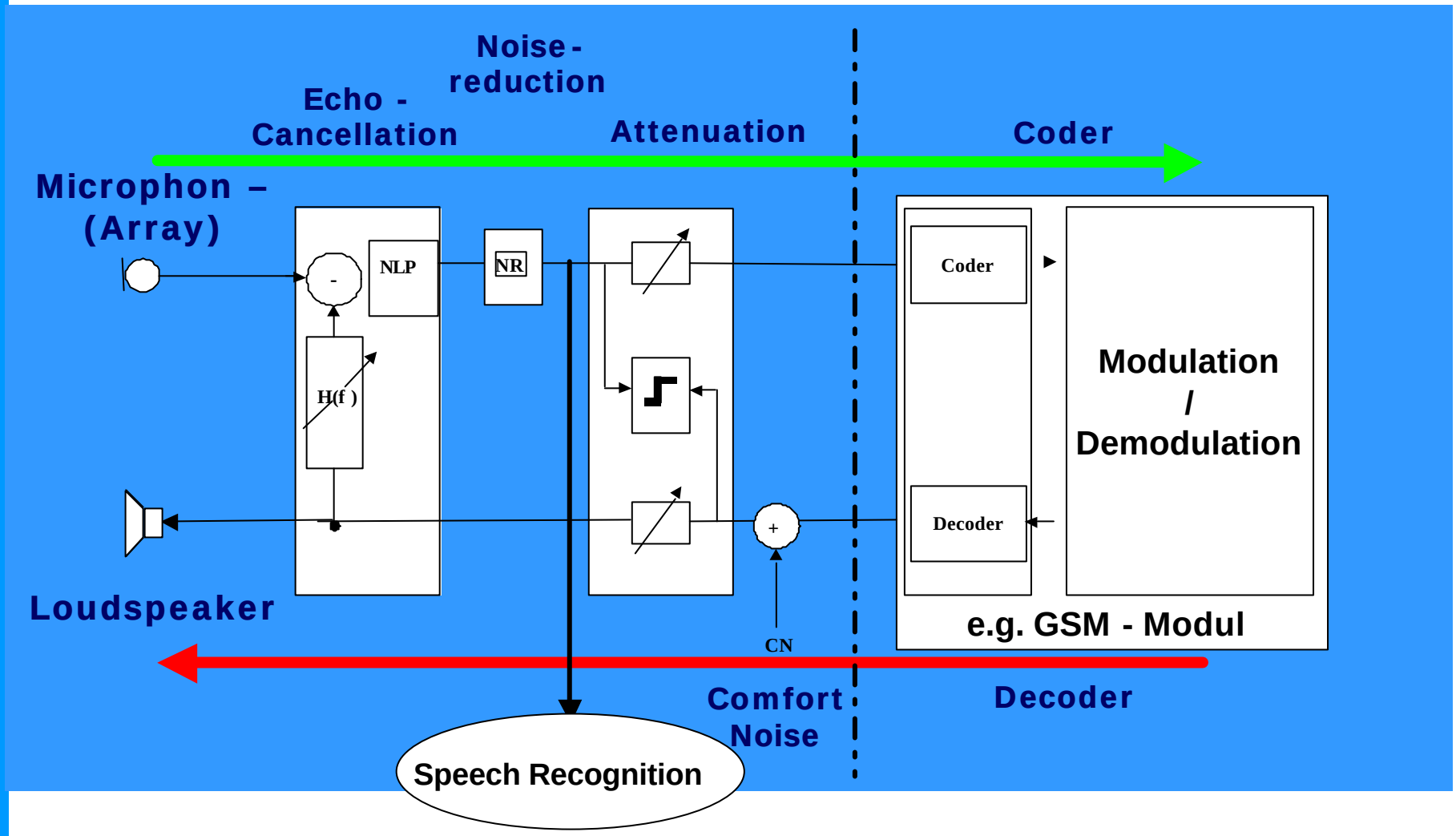
Hands-Free Signal Processing



Parameters Relevant to Quality
(and covered mostly by the tests in the VDA specification)

- ***Speech quality as perceived by the user:***
  - **(Speech) sound quality**
  - **Delay and echo**
  - **Double talk capability**
  - **Switching and echo during double talk**
  - **Loudness**
  - **(System) noise**
  - **Quality of background noise transmission**

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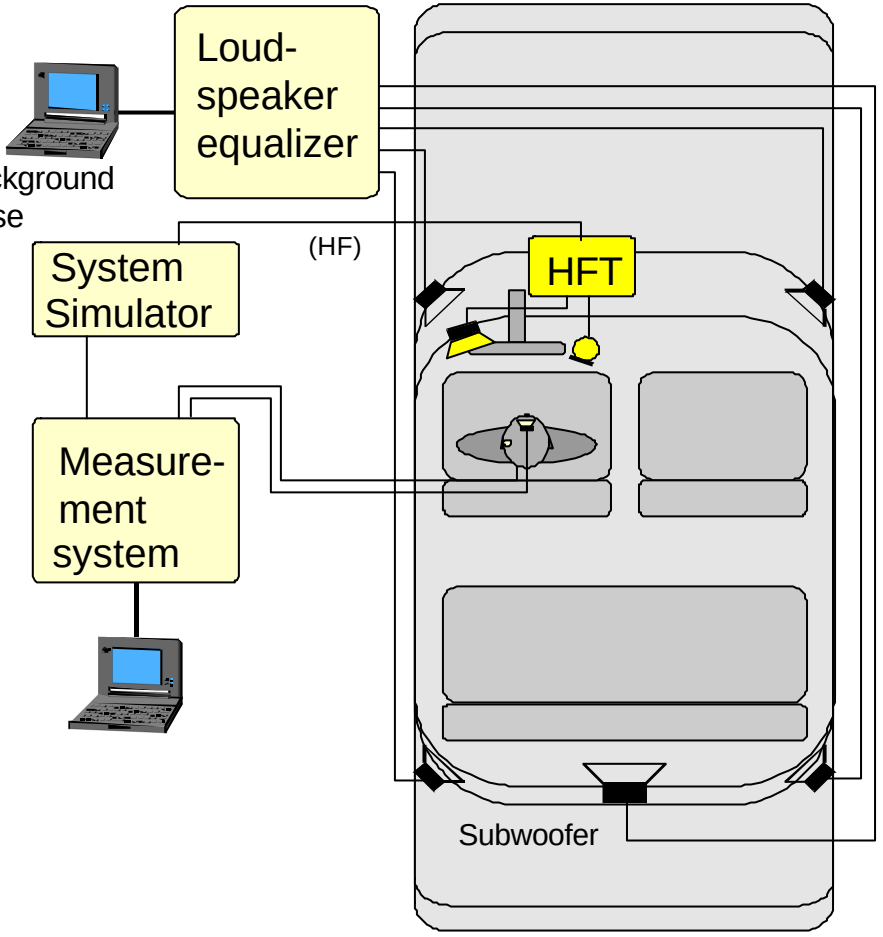
Test Setup

- real car cabin
- installed hands-free terminal
- System simulator (GSM, …)
- HATS **H**ead **a**nd **T**orso **S**imulator (ITU-T P.58, P.581)

- *Tests:* ***VDA Specification / new work in ITU-T SG12***
- ***Background noise simulation ETSI STF 273***



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The ETSI STF 273 Project

- Scope:
  - Defining background noise simulation scenario for laboraty use

  to be used for
  - Objective performance evaluation of terminals and codecs
  - Subjective evaluations in third party listening tests or conversational tests

=> ETSI Guide EG 202 396-1

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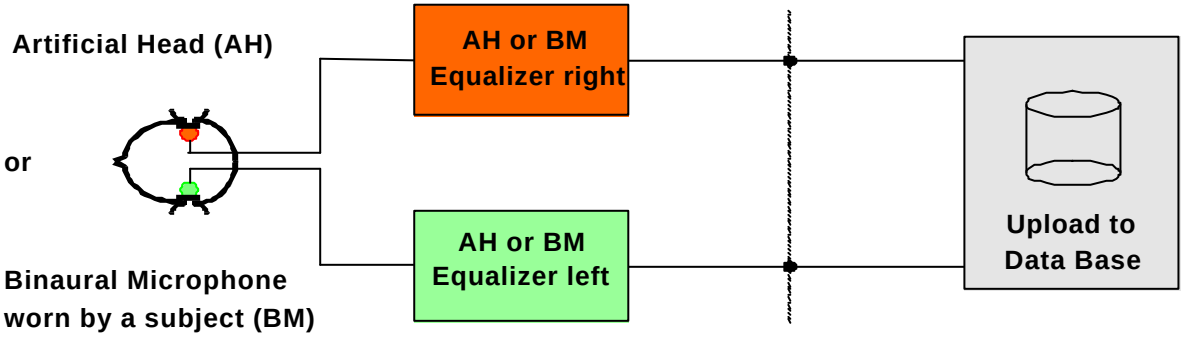
Requirements

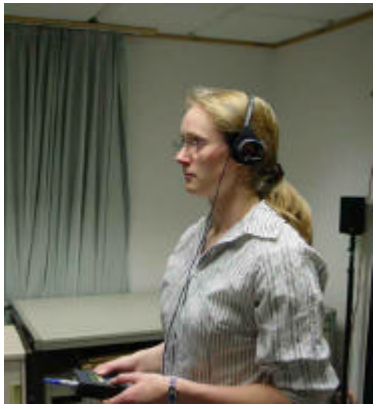
- **Requirements for the recording procedure**
  - Easy to use
  - Easy to calibrate
  - Capable for wideband systems

- **Requirements for the simulation arrangement**
  - Easy to setup
  - Easy to calibrate
  - Insensitive to different types of test rooms and positioning of test-objects
  - Applicable to all types of terminals

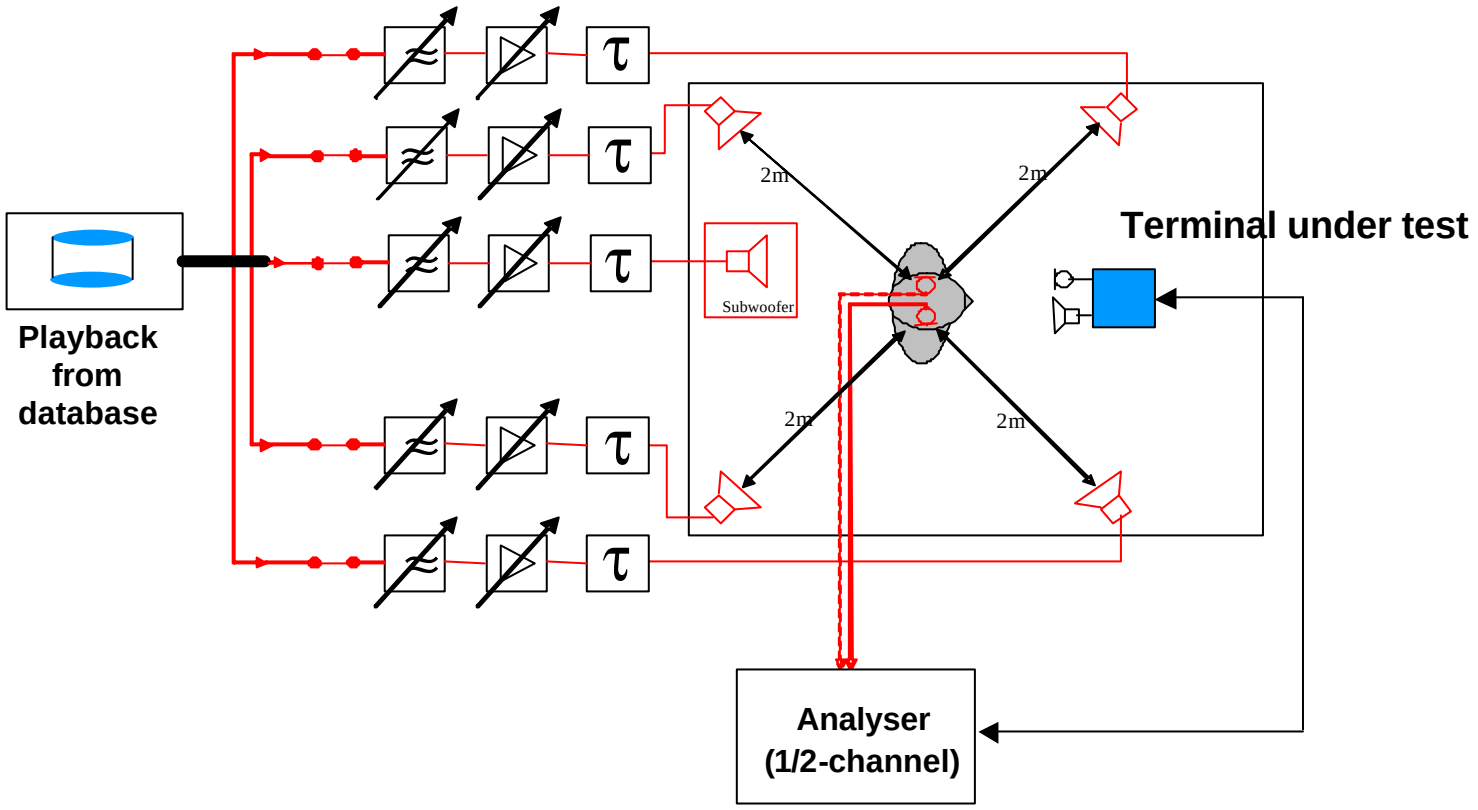
The Recording Setup

- Recordings for the setup in office rooms with
  - Artificial heads (ITU-T Rec. P.58) or
  - Binaural probe microphone (MIRE technique)



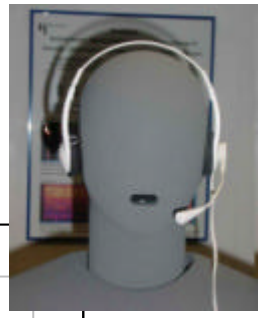


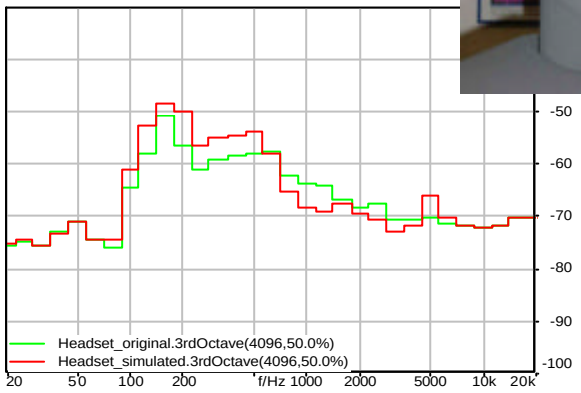
The Background Noise Simulation Setup: 4.1 - Technique



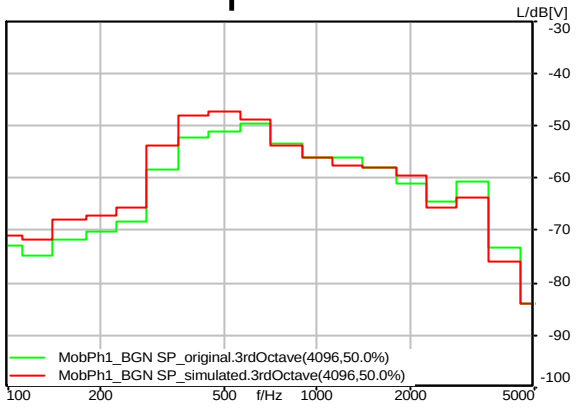
Comparison of Terminal Performance

Headset

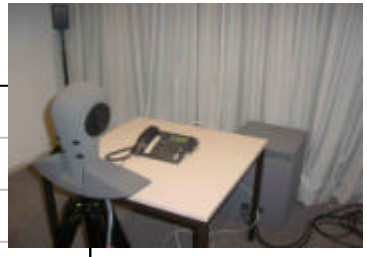


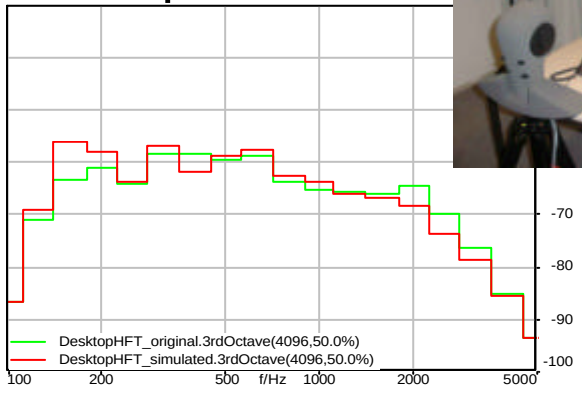


Mobile phone



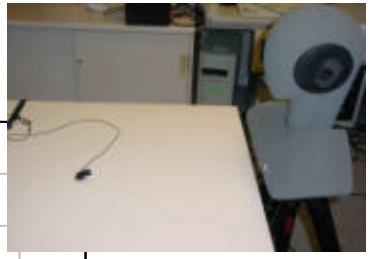
Desktop HFT

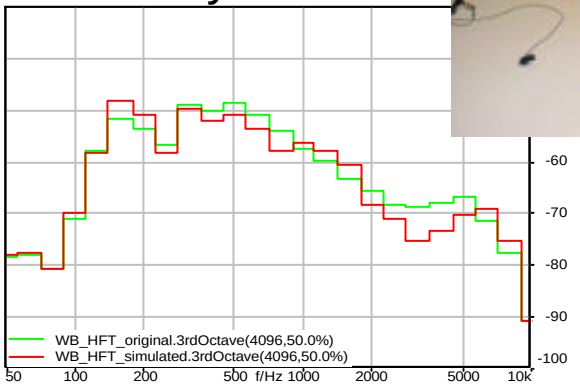




Green - original
Red - simulated

Wideband conference system





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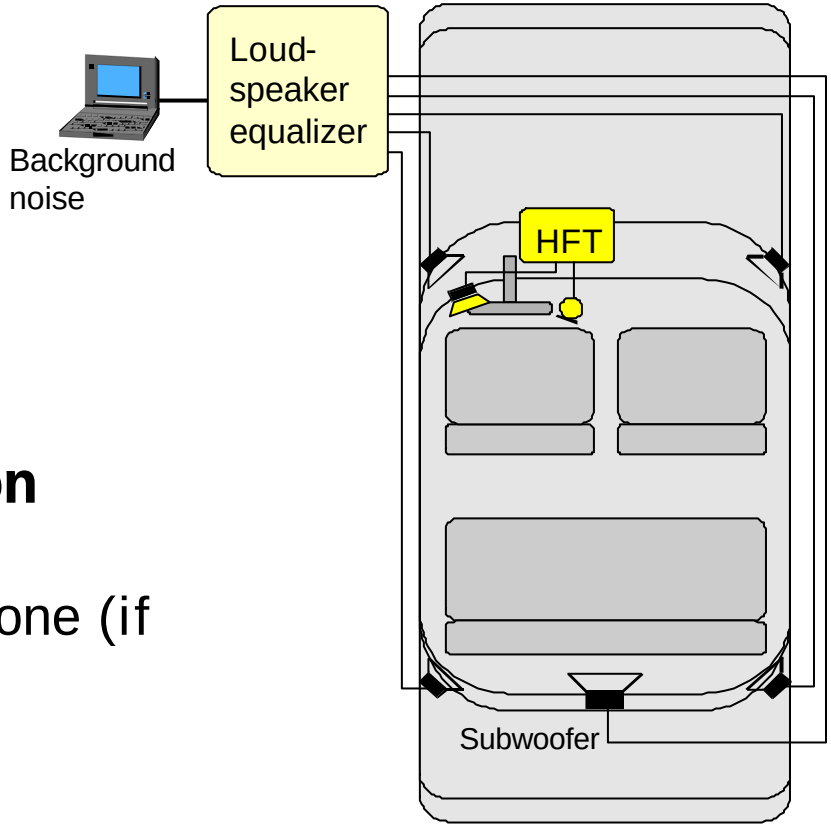
4.1 Simulation System in Cars

- **Modified setup:**



- **Choose equalization microphone:**
  - Terminal microphone (if accessible)
  - Pair of cardioid microphones

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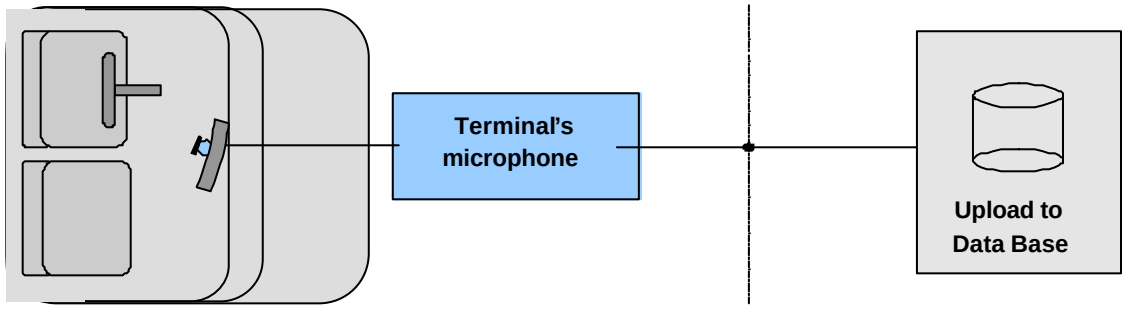
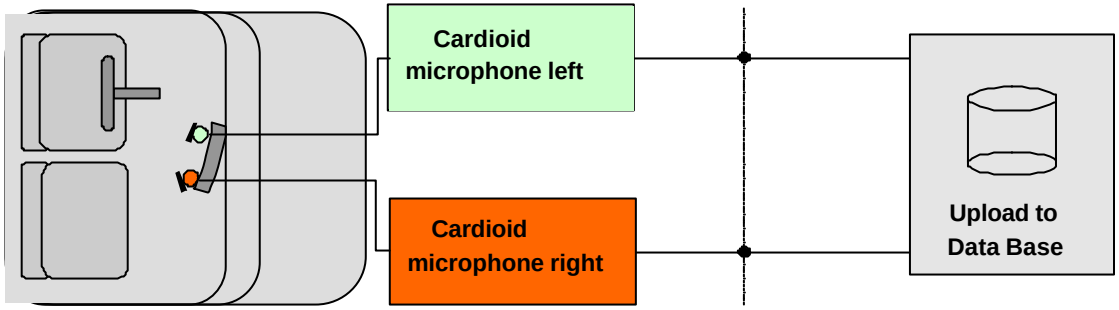
Recording Setup in Cars

- **Driving with constant speech**
  - when equalizing with terminal microphone



  - when equalizing with a pair of cardioid microphones



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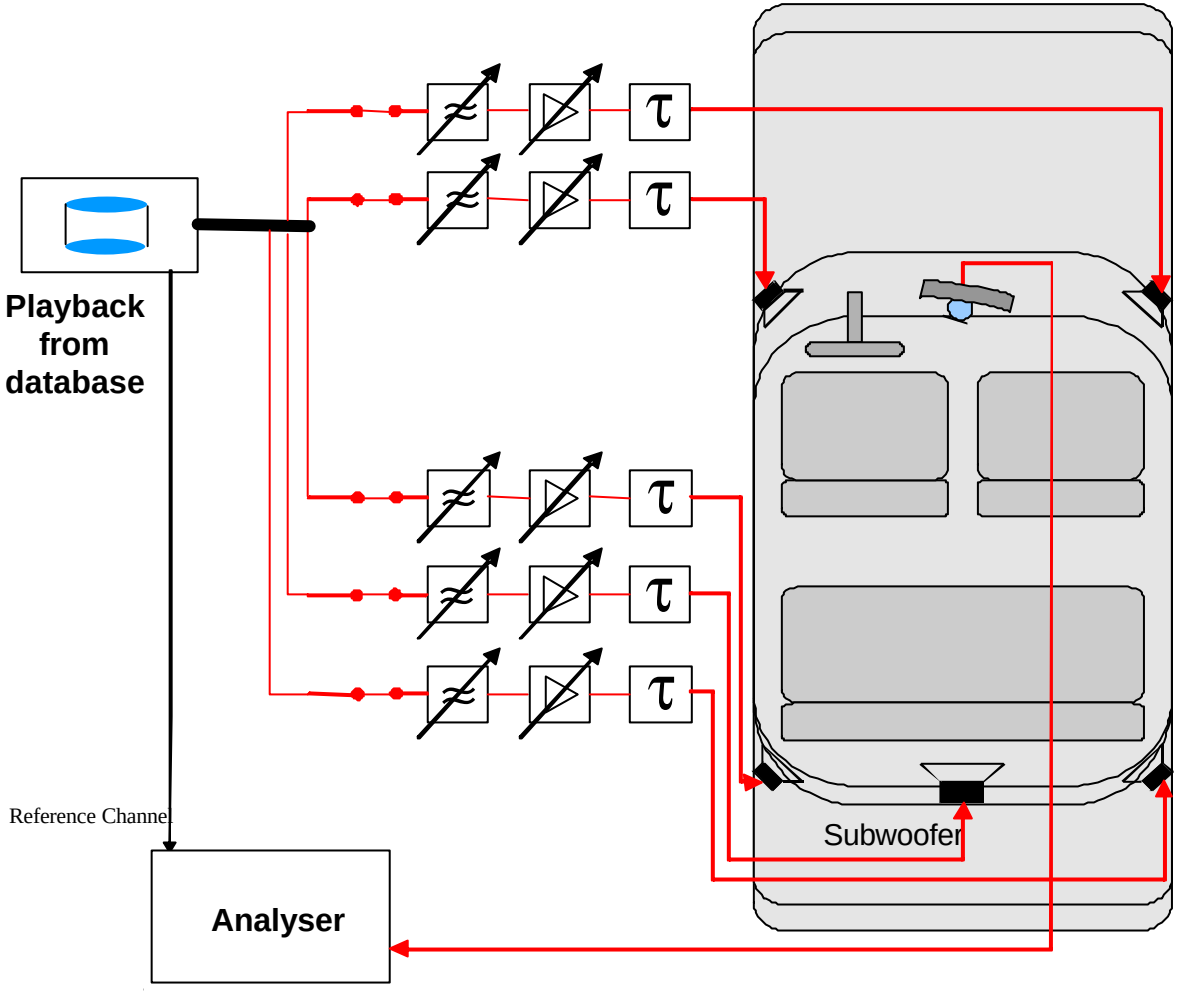
4.1 Playback Setup in Cars



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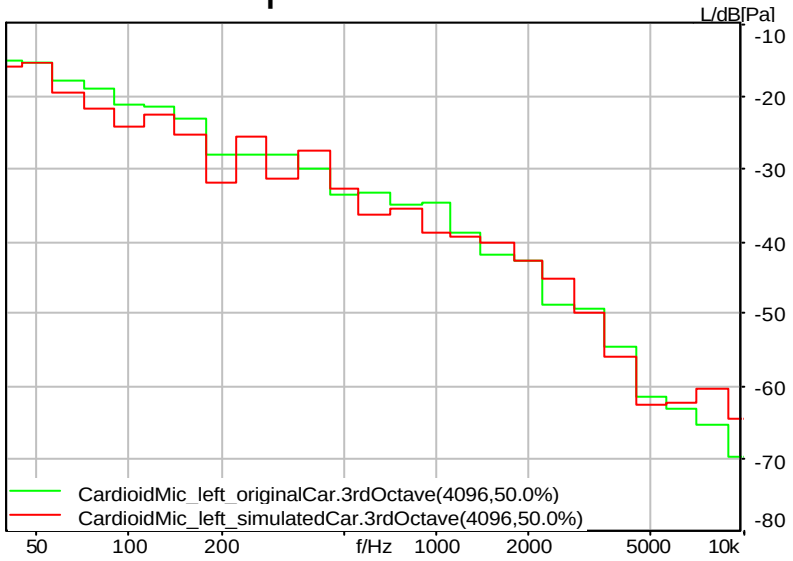
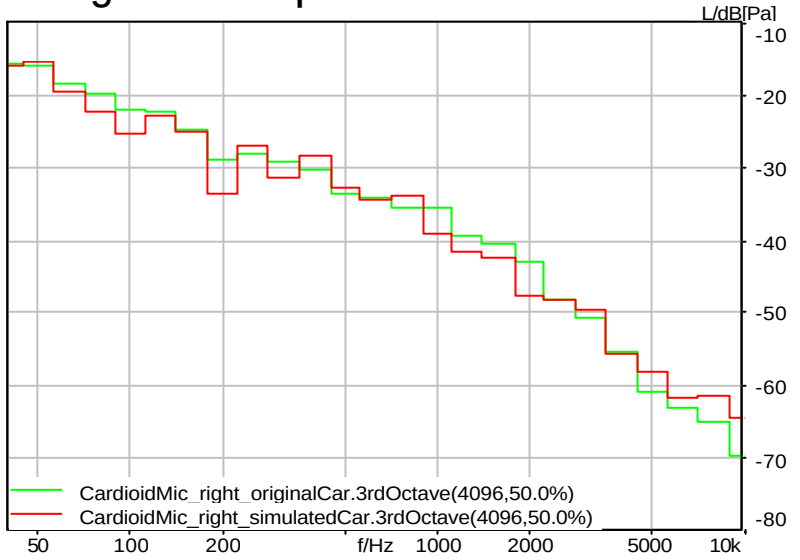
Accuracy of the 4.1 System in Cars

- **After equalization with a pair of cardioid microphones:**

- left microphone



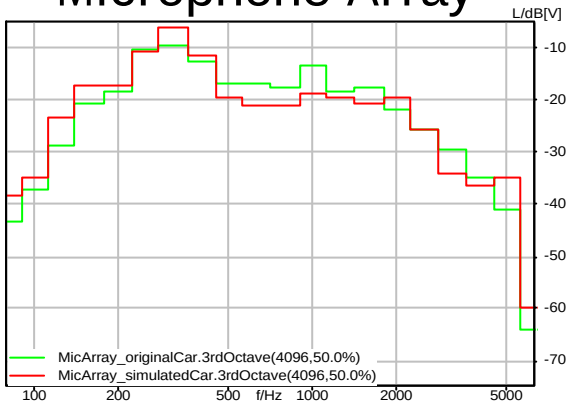
- right microphone



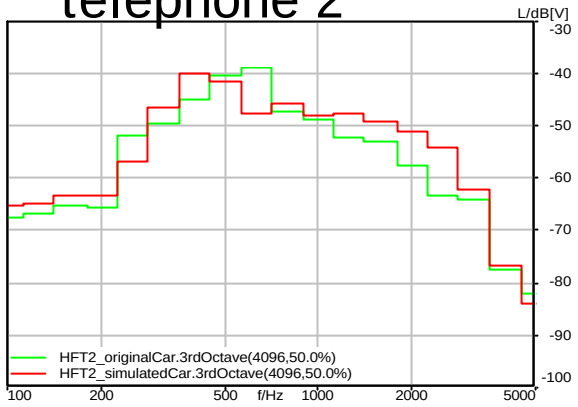
Green - original
Red - simulated

Comparison of Terminal Performance

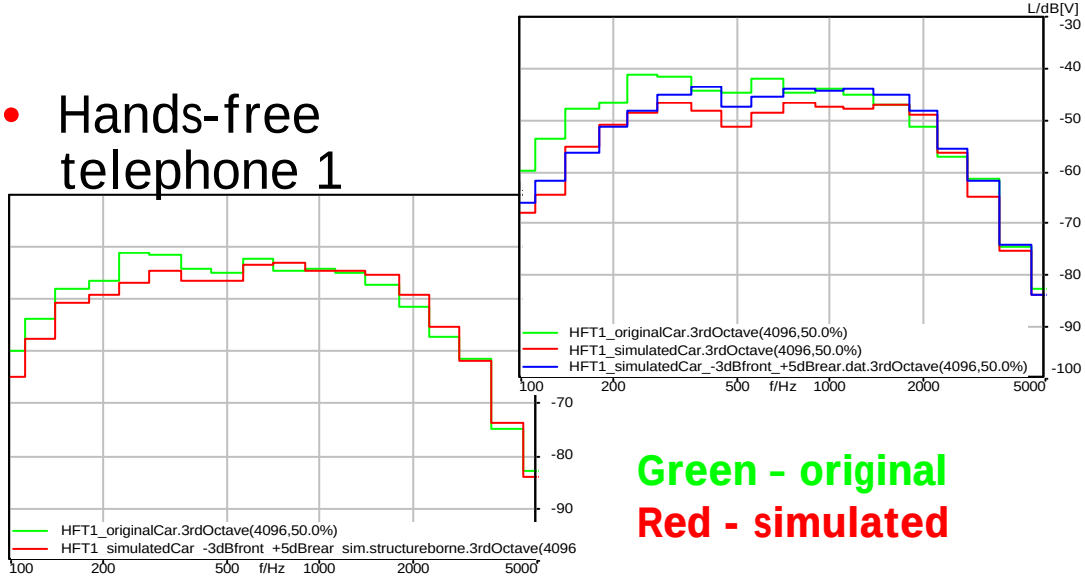
- Microphone Array



- Hands-free telephone 2



- Hands-free telephone 1



Green – original
Red - simulated

Conclusions & Further Steps

- 4.1 simulation system suitable for simulations in
  - standard office rooms
  - Cars
- Easy setup, calibration and equalization

- Next steps: setup of background noise database
  - Sound sources for play back in office rooms and cars
  - Development of an objective method for speech quality evaluation in background noise situations

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