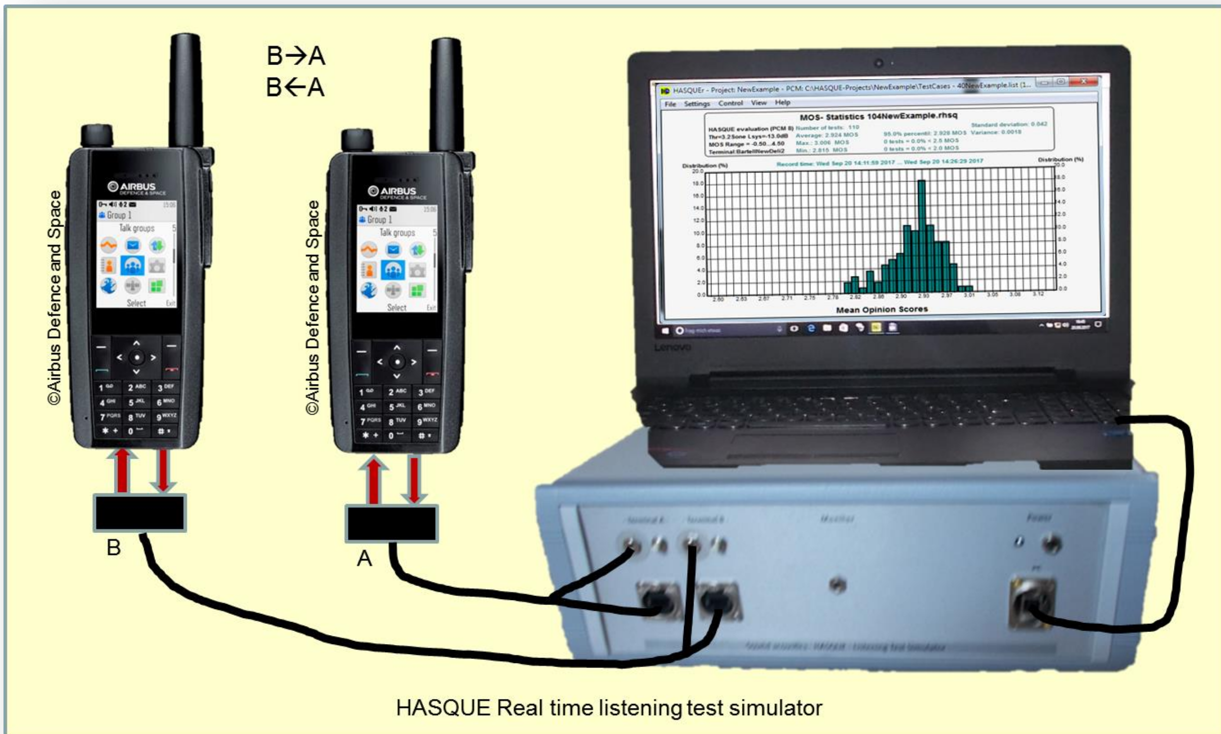
HASQUEr

-Real Time Listening Test Simulator-



HASQUE Real time listening test simulator

The solution for real time and offline quality evaluation of

Audio- and Telecommunication Systems

Content

Intended Use:

Real Time Evaluation of telecommunication systems

HASQUE real time measurement systems operate with bi-directional analogue interfaces which are sampled with high quality 24 Bit AD and DA converters at 48 kHz sampling rate.

A **hardware test program** is made available for the user providing both, a **function test** and an **automatic level adaptation** between system under test and measurement system.

Both functions are easy to use, need not more than some minutes to be carried out and ensure a correct quality evaluation of the system under test.

The hardware test program applies among others a special test signal (Bartlett burst) which is suitable to measure the signal transfer properties (level, distortions, SNR) of most systems under test. The Bartlett burst was developed in order to make measurements at systems with automatic sine wave suppression or signal degrading codecs possible.

What kind of test samples and how many tests are to be carried out, or if test cases should be repeated are application dependent decisions, which can be determined by the user with the aid of a task editor belonging to this measurement system. The task editor provides easy tasks for the **measurement control** and a compiler for error check and task script creation.

The measurement control operates after start according to the user defined tasks and creates recordings, file lists and measurement results with general results over all, histograms and single results.

Quick function test

The function test indicates immediately after start of the hardware test program the graphically representation of the Bartlett burst at the signal interfaces and in the legend measurement results about current level, distortion and SNR (Figure 1).

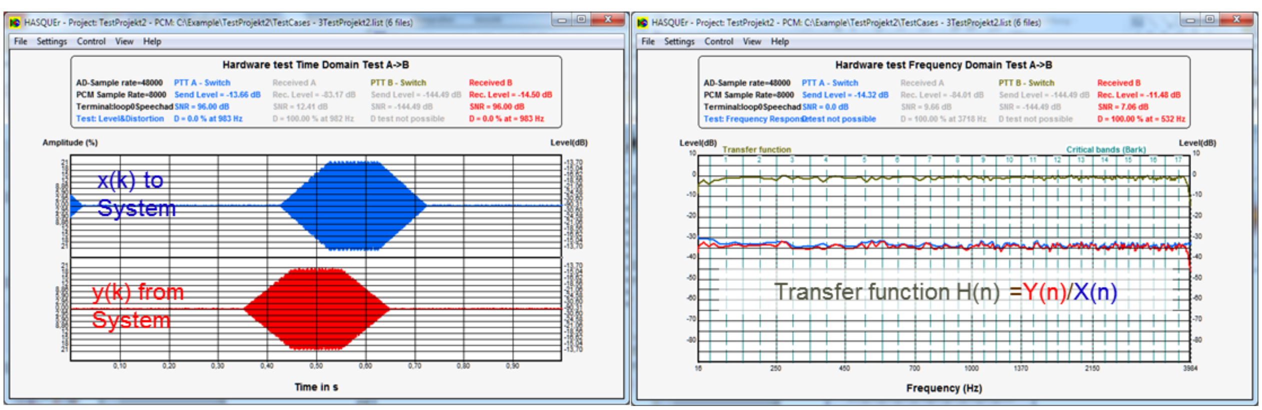


Figure 1: Function test of the connected system under test by simple mouse click

The reproduction of the received Bartlett burst (y (k)) makes assumptions about the system properties possible. Deformed edges of the indicated sextant point to an AGC influence and a concave dent in the middle of the sextant points to an error or mismatch in the system.

The test of the transfer function of the connected systems is carried out very quickly by mouse click in the legend and shows the current spectra at the interfaces and the corresponding transfer function of the system under test.

All necessary measurement functions were developed especially for these quick tests, in order to ensure a reliable error free operation between measurement system and system under test for a reliable quality evaluation.

Automatic level adaptation

The interface levels between measurement system and system under test can be well adapted with the aid of the automatic level adaptation through which a low measurement tolerance (typ. < 1%) and thus reproducible measurement results are achievable.

Automatic level adaptation takes place with the aid of a wizard as shown in Figure 2 through which nearly any manual possible mismatch can be excluded.
The applied measurement programs behind the wizard apply above mentioned Bartlett burst for the finding of the maximum interface levels and adjust the necessary send and receive gain of the measurement system to reach a distortion free measurement operation.

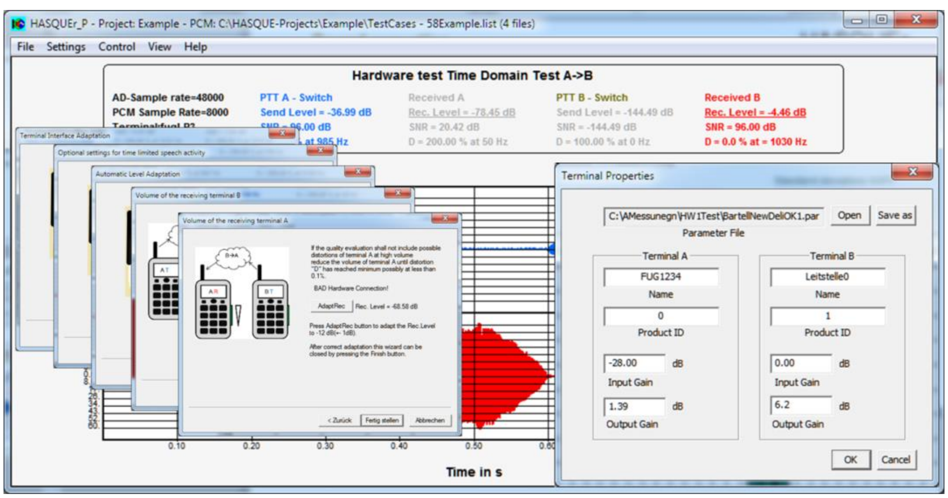


Figure 2: Automatic level adaptation between measurement system and system under test

The wizard opens a dialog box with the found settings and provides edit fields for the description of the connected hardware after automatic level adaptation.

The whole content of the indicated dialog box can be saved after all in a terminal parameter file with the user defined name for future measurements to be repeated with the same system under test.

Task editor for measurement control

Real time quality evaluation based on listening test simulation with audio samples is started with the aid of a programmable task interpreter. The task interpreter is used to control the measurement system, the

measurement direction, the connected system under test, the individual selection of the reference samples and the recordings from the system under test.
HASQUE r is fitted with an individual programming (TIP) task editor for the coding of the task interpreter, by which the measurement control is checked during compilation before start of real time measurements.

Offline evaluation of PCM recordings

Offline evaluation offers in addition to the listening test simulation of post processed recordings numerous measurement functions for error tracing and error analysis of audio and telecommunication systems and thus is even so suitable for quality enhancements of the systems under test.

Offline measurements are carried out with windows conform PCM signals (*.wav files). It is possible to carry out single and series measurements. The sample rate of the measurement system is adapted to the sample rate indicated in the header of the audio files. Statistics about quality measures, latency and speech interrupts are computed in conjunction with series measurements.

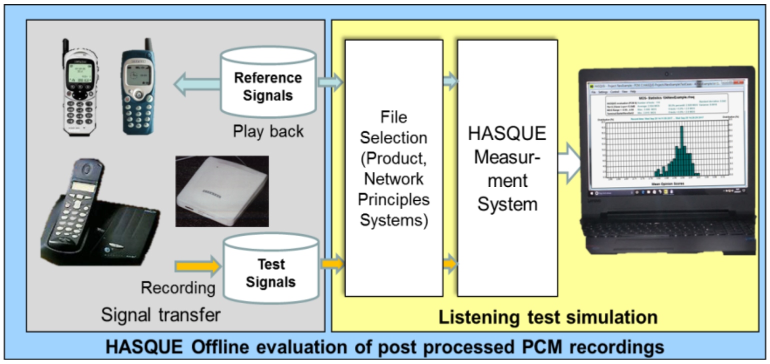


Figure 3: Offline measurement system

Series measurements are carried out with file lists, which can be created with the aid of a special editor for easy composition of different test cases. An import function for compressed RST-files extracts the belonging reference and test cases, creates the corresponding file list and releases the selections for evaluation.

The entire functions of the offline measurement system as well the following indicated measurement results and representations are part of the real time measurement system.

Measurement results

Quality Measures

The quality evaluation is based on the HASQUE® principle which compares the output signal with the input signal of the system under test by hearing adequate functions in the digital sampled domain. The quality measure indicates the objective Mean Opinion Scores according to ITU standards on the five point MOS scale with Excellent = 5, Good = 4, Fair = 3, Poor = 2 and Bad = 1. A preset button provides also settings for narrowband evaluations (300…3400Hz) with corresponding mapping function according to the scale of the ITU-T P.862 and ITU-T P.863 recommendations.

HASQUE is taking individual frame conditions of application dependent listening tests into account. Listening test conditions as the bandwidth, the listening loudness and the threshold of acceptance can be adapted to a large field of applications.

Statistics

The statistic evaluation of measurement results (Figure 4) of the system under test provides valuable hints about the system properties with one view.
Statistics with belonging histograms are computed and indicated for quality measures, latency and speech interrupts making clear conclusions about the system behavior of the system under test possible.

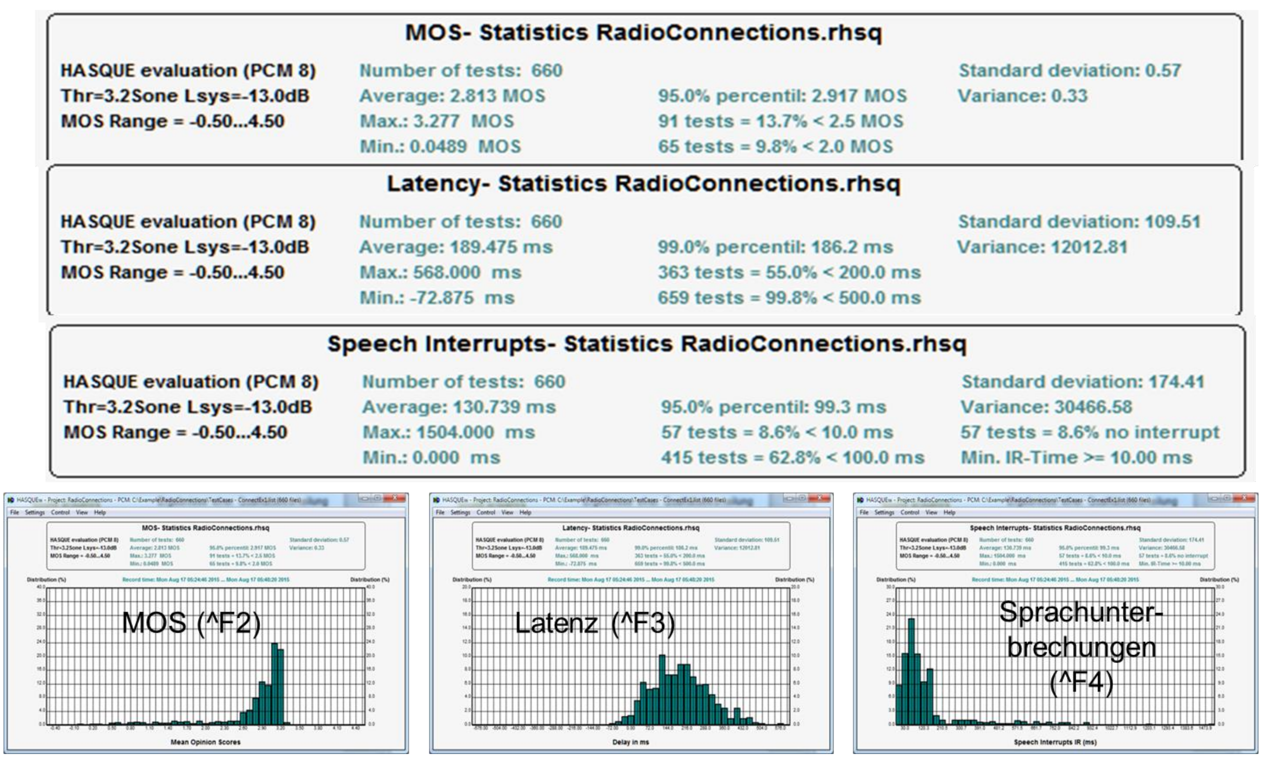


Figure 4: Statistics about the system under test

The number of tests, the arithmetic average magnitude, the maximum and the minimum Value, the standard deviation and variance are indicated in the legend of the histograms. The percentile and the number of tests which exceed an upper and lower programmable threshold are indicated in the legend in addition.

The percentile indicates the average magnitude of most frequently appeared measurement results within the indicated percentage of measurements. The indicated percentage of the percentile is programmable making the exclusion of runaways for the average magnitude derivation possible.

Also upper and lower thresholds are programmable making statements about the number of test cases which are in the range of still and not accepted measurement values.

General view of measurement results

HASQUE measurement systems provide general views of results by which the user can recognize when and where critical test cases occurred with one view (Figure 5).

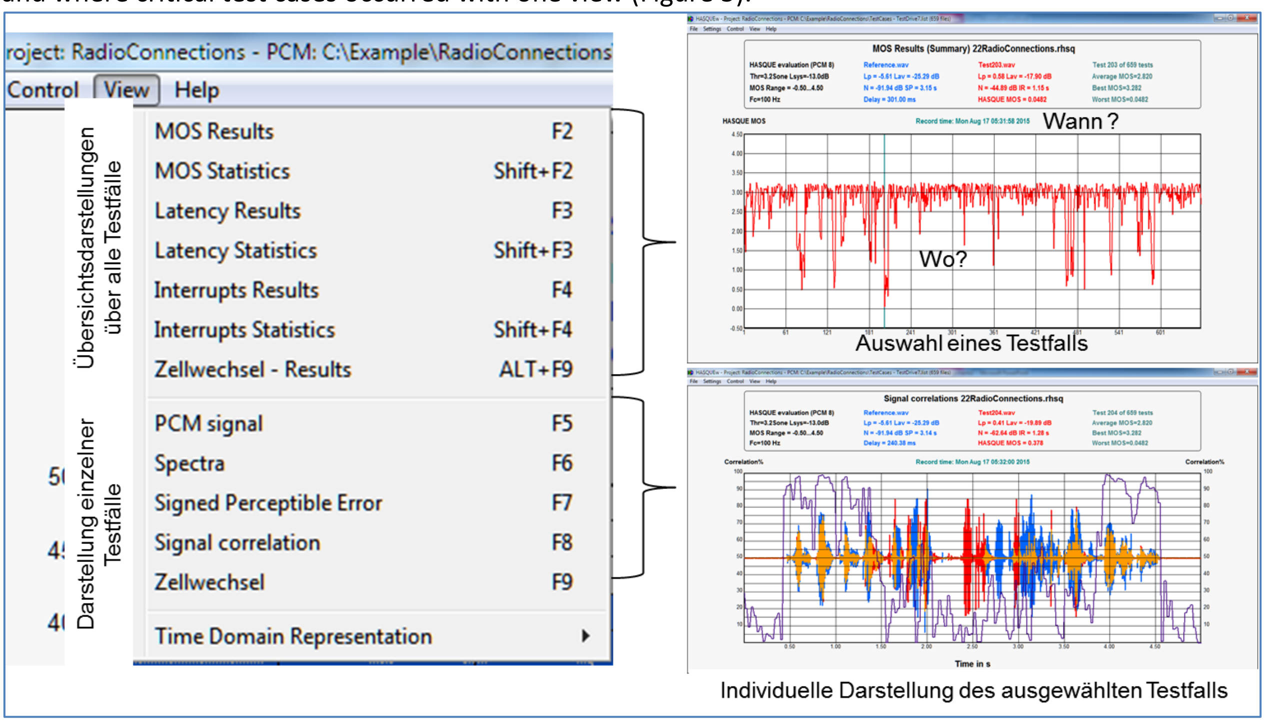


Figure 5: Time saving selection of single results - easy error recognition

General views of results are made available for different properties as speech interrupts, MOS, latency and an individual programmable error type (e.g. “Zellwechsel”) for individual examinations.
The choice of single test cases takes place by mouse click in the represented general view making the access to conspicuous test cases possible for detailed examinations in time and frequency domain.

Single test results

Easy access to single test results of interest is made possible by mouse click in general views and with the indicated minimum and maximum statistics in the legends by the graphical user interface.

Measurement results of selected test cases are indicated in the legend of each individual representation. Single results in time domain might be zoomed and time shifted in order to make conspicuous passages visible for enhanced examinations. With the aid of the playback function it is possible to evaluate and compare selected zoomed passages by listening.

Following representations and measurement functions are made available for examinations.

Perceptible errors

Figure 6 shows a selected test case with belonging perceptible error (brown curve). Selected passages can be listened and compared with the belonging reference signal in order to hear what we see.

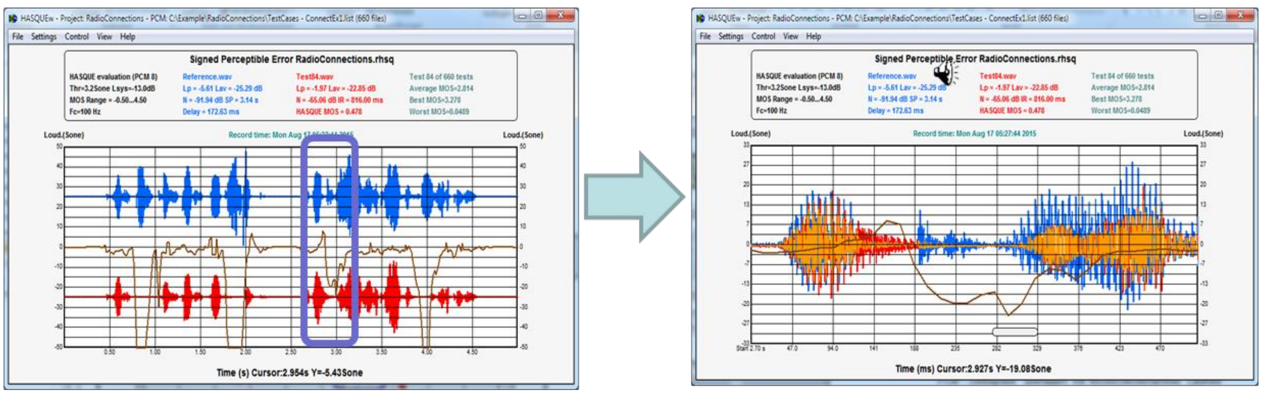


Figure 6: Perceptible error in time domain in order to see what we hear

Signal correlation

Differences between input and output signals of the system under test which are not recognized precisely by the perceptible error due to natural masking effects can be examined with the aid of the correlation analysis.
Undistorted signals - i.e. the output signal equals the input signal - are indicated with 100% correlation. The indicated correlation over the time axis in percentage makes statements about the similarity and thus about the probability for the existence of artefacts or other signal distortions possible.
Variations of correlations over the time axis show the time and frequency dependent precision of the signal transfer. Signal correlations are applied as error property for the evaluation of classified errors leading to a high error recognition rate.

Latency shifts and jitter which might be introduced by the system under test are eliminated for the derivation of signal correlation and so in the graphically representation.

Spectral representation

HASQUE measurement systems indicate spectra with hearing adequate frequency distribution and the corresponding critical bands on the Bark scale. This representation relieves examinations by enhanced interpretation -what we see is that we can hear.

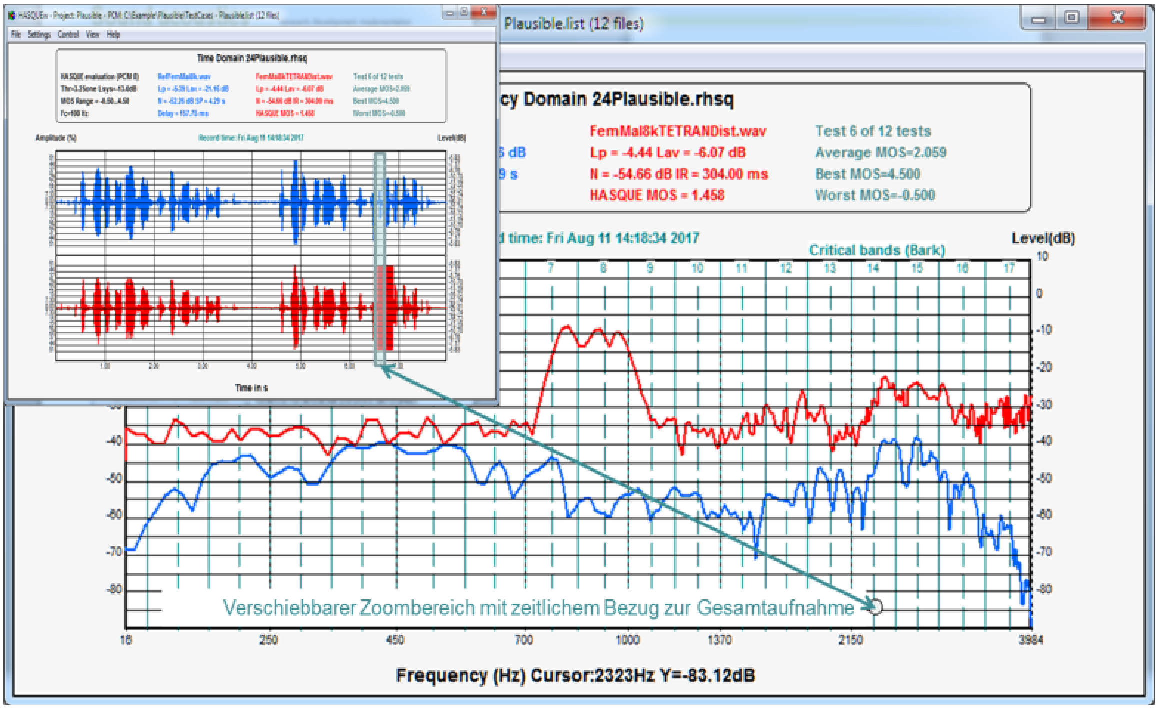


Figure 7: Frequency representation of a zoomed time section

The spectral analysis Figure 7 is always carried out in the selected time window and will be continuously renewed during shifts on the X axis of a zoomed time signal. Hence signal errors can be traced and examined in the frequency domain most precisely.

Error classification and error recognition

Signal errors might be caused by different reasons. The error classification allows individual determination of an error type as e.g. signal interrupts by weak radio connection, artefacts by cell reselection or acoustic distortion by alarm signals.

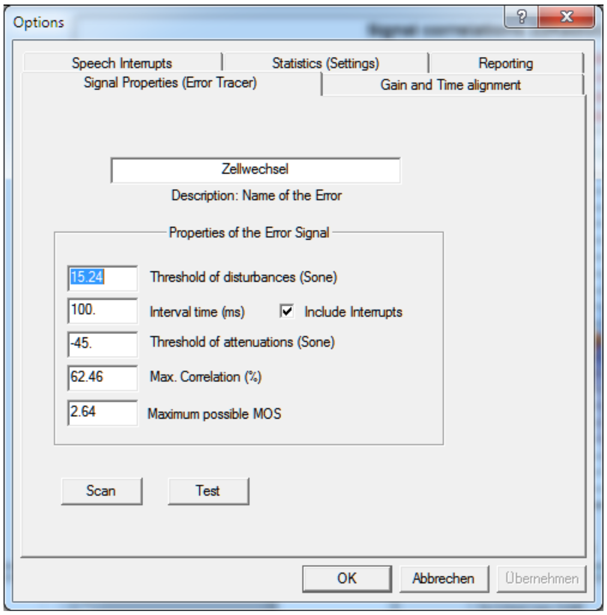


Figure 8: Error description and classification

The error classification is carried out with the aid of the dialog box "Signal Properties" Figure 8. The name of the error can be defined individually and is indicated in the graphics and corresponding menu items as shown in Figure 5.

The description of the error type properties can be found out automatically with the aid of a scanner.

The user can mark the error of interest by zooming in the desired graphically representation. Error properties are scanned from the representation and are taken over with finishing the error scanner wizard

It can be checked if the error recognition operates correctly by a test button which opens the graphic for the indication of the new defined error.

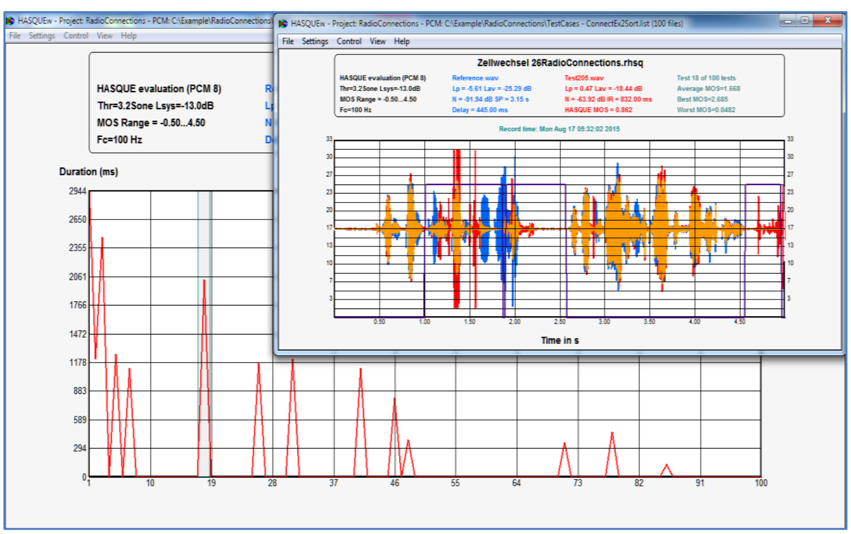


Figure 9: General view and single test case of an individually classified error

The error tracer is finding out the defined error and the duration of the error for each test case.

Individually defined errors can be examined in the general view with duration and time indication and so for each test case as shown in Figure 9.

The recognition rate for individual defined errors depends on the error type and can be improved by iterative fine tuning of the properties with wrong interpreted test cases.

Hardware:

The Hardware is consisting of following parts:

1 HASQUE Listening Test Simulator Hardware System

1 Power supply

1 USB cable

Figure 10: Listening Test Simulator Hardware System

Hardware interfaces:

1	3.5 mm Jack	PTT control cable to terminal A or B
2	PTT key	manual PTT control
3	Audio Port	symmetric bidirectional analogue audio signals
4	3.5 mm Jack	monitor output to headphones
5	Power supply jack	Power supply
5	USB2.0 Port	USB connection to PC

Audio ports can be equipped according to customer requirements on request (RJ45, XLR, 6.3 mm Jack…).

Software features:

This HASQUEr software is designed for windows operating systems and will be provided online for download from our homepage. Software upgrades are made available in conjunction with a software maintenance contract.

This software provides among other following features:

- Real time evaluation
    - Hardware test programs
        - Quick function test
        - Automatic level adaptation
    - Task editor real time measurement control
      TIP-programming
    - Zero delay calibration
    - Signal delay (Latency) measurement and compensation
    - Automatic PCM file recording (8, 16, 24, 48 kHz) *.wav
    - File list creation
    - Individual and prepared listening test settings
    - Test signals for tests and evaluation:
        - Bartlett burst
        - Sinusoid
        - White noise
        - Butterfly sinusoid and noise
        - Sweep
        - Impulse
        - User defined reference files
          Windows PCM (wav), Intel, 8, 16, 24, 48 kHz, 16 Bit, mono
- Offline evaluation
    - File selection: File list generator for the collection of PCM test cases to be evaluated, single file selection, RST file conversion into PCM file lists
    - Programmable time and gain alignments
    - Individual and prepared listening test settings
    - Play back of PCM selections (GUI controlled)
    - Zooming, shifting and scaling
    - Sample rate adaptation
    - Picture generator based on EMF vector graphics
- Representations
    - MOS results summary about all tests of a test series
    - MOS statistic distribution curve, percentile, standard deviation, variance, thresholds
    - Delay results summary about all tests of a test series
    - Delay results statistic distribution curve, percentile, standard deviation, variance, thresholds
    - Speech interrupt results summary about all tests of a test series

  - Speech interrupt statistic distribution curve, percentile, standard deviation, variance, thresholds
  - Individual error results about all tests (error classification and error tracer)
  - Time domain separate representation of reference and test signal
  - Time domain representation of reference and test signal - single, separate, merged
  - Frequency domain representations of reference and test signals
  - Signed and unsigned perceptible error
  - Correlations between test and reference files
  - Individual error (error classification and error tracer)
- Results
  - EMF file including the picture about the statistics of the results
  - HASQUE Riff Result file for easy access to the applied test cases
  - Text (ANSI) including lists about measurement results of each single test

- Online help books

Technical Data:

Analog interface (RJ45 Terminal)

Bandwidth	20 Hz - 23000 Hz
Max. Input Level	-1,12 dBu
Input Impedance	1.1 kΩ
Max. Output Level	-1,12 dBu
Output Impedance	710 Ω
SNR	typ. 90 dB
THD (1kHz)	typ. 0.1 %

Monitor

Output power	2x6mW
Output Impedance	40 Ω
Output Level	-30 dBV

USB

Specifications	USB 2.0

AD Converter

Sample rate	48 000 Hz
Bits per Sample	24
Format	Windows PCM (wav)
Ambient temperature limits	0 - 40 °C

Computer

Operating System	Windows 7 … 10
Processor	AMD A4-4000 APU with Radeon (tm) HD Graph.
	3000MHz, 1 Core, 2 logical processors.
Memory (RAM)	> 2 GB

HASQUE specifications

Sample rate	adaptive to the applied reference files
[1]Bandwidth	programmable
Latency accuracy	typ. 0.1 ms
Maximal delay	1 sec
[2]MOS range	programmable
[3]Threshold of acceptance	programmable
Max. Input level	0 dBFS
Max. Output level	0 dBFS
[2]System level	programmable
Level control	-20 dB ... +6 dB, step size 0.1 dB
[1]PCM Format	Windows PCM (wav), Intel, 8kHz, 16 Bit, mono
Results (Picture)	Enhanced Meta Files (EMF)
Results (Text)	ANSI
Results (HASQUE)	RIFF, RHSQ Files

Literature:

1. Sound acoustics Literatur: *HASQUE*

[1] Conditions are adapted to any sample rate of the reference files automatically for offline evaluation. Real time evaluation supports 8, 16, 24 and 48 kHz samples
[2] The MOS scale can be adapted to individual requirements
[3] Listening test conditions can be adapted to individual requirements