White Paper

Case Study

GSM Voice Quality Measurement In Faded Channel Conditions

Characterizing the service quality of wireless handsets

Metrico Wireless LLC
12800 Frederick Road
Suite 202A
West Friendship, MD 21794
Phone 800-741-6421
Fax 443-638-0272
www.metricowireless.com
info@metricowireless.com

Abstract
This paper outlines methods for evaluating wireless handset service quality through the analysis of voice quality measurements taken under faded channel conditions. In particular, the paper considers voice quality measurements collected from handsets resident in a simulated radio environment.

Introduction
Evaluating a mobile handset's performance using voice quality measurement provides insightful understanding of over-all handset performance and user-experience. Voice quality measurement offers the advantage of exercising both the radio subsystem and base-band processing subsystem for a mobile handset. This contrasts with testing that measures RxQual, BER or FER and focuses on exercising only the radio subsystem. The base-band processing subsystem performance, including the voice codec and related DSP processing, has been found to vary across mobile handset models; resulting in a varied user experience even under the same radio conditions.

Faded Channel Test Environment
The faded channel environment is created through the use of a BTS Simulator and Fading Simulator. The BTS Simulator provides for the generation of the radio environment and air-interface for the test call while the fading simulator enables the systemic degradation of the traffic channel through various fading profiles.

Channel degradation is additionally achieved by superimposing AWGN over the control signal. The degree to which the channel is degraded can be set by controlling the ratio of Eb/No in the fading simulation.

In the sample results provided below, voice quality measurements were taken for four Eb/No settings.

Measurement Methods
Voice Quality Measurement
Voice quality is effectively measured using standardized models that predict quality scores traditionally determined from subjective tests with human listeners. PESQ, an ITU-T recommendation P.862 standardized model for predictive speech quality, utilizes speech signals that are subjected to the communications link under test and compares the degraded speech to the original speech. Speech quality scores are provided on a 5-point scale (MOS-like listening quality score).

Score	*Quality of speech*
5	Excellent
4	Good
3	Fair
2	Poor
1	Bad

Determination of voice quality sample size
The sample size, the quantity of voice quality measurements, will vary based on the desired statistical confidence level and the observed variance of the voice quality measurements in each degraded channel condition. Generally, the more degraded the channel condition the higher the voice quality variance and the greater the number of voice quality samples required.

Voice coupling method
When measuring voice quality performance in a lab-based test scenario, electrical coupling and acoustic coupling may both be used.   The primary advantage of electrical coupling is that it eliminates the potential for introduction of unwanted (external) sounds affecting the voice quality scores.   Acoustic coupling via a ITU-T P.57 compliant device may also be used if sufficient acoustic isolation is available and if testing of accessories is desired such as Bluetooth headsets.

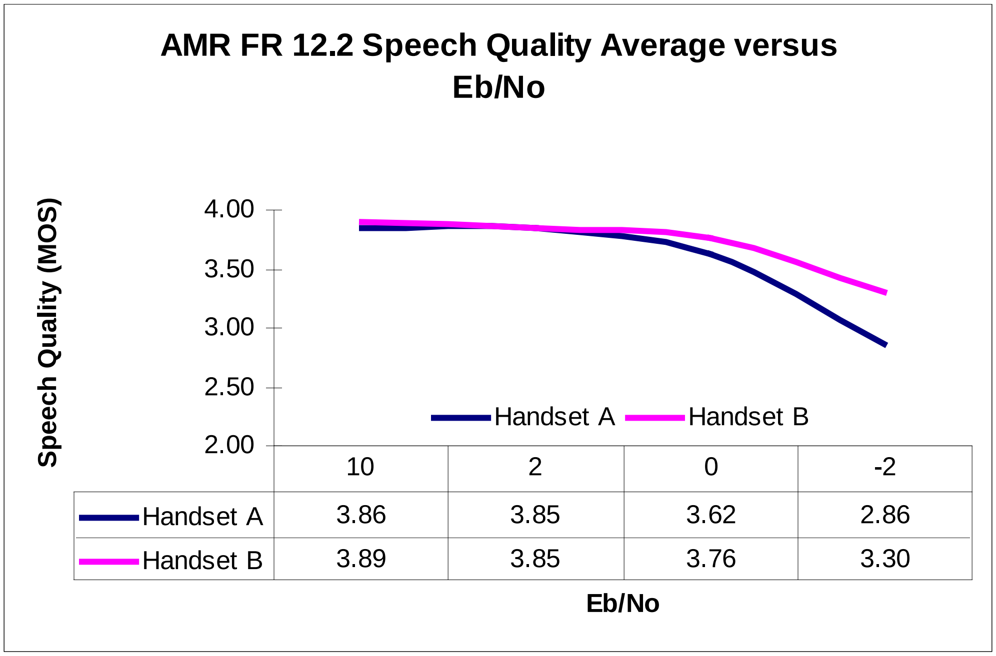
Performance Evaluation – Sample Results

Voice quality measurements collected through empirical study can be evaluated using common statistical inference methods.   Statistical comparisons of the average voice quality and standard deviation of voice quality from a particular set of samples may be considered for statistical inference conclusions.

This case study presents results from tests of 2 handsets (of the same model); one of which has performance improvements centered on interference cancellation techniques.

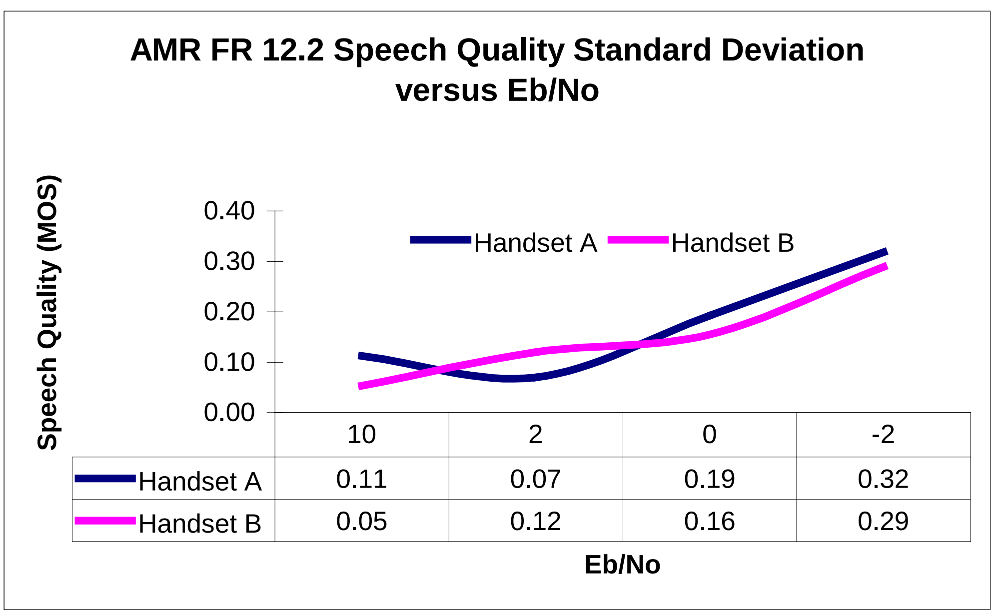
Analysis of voice quality average by channel condition

In this analysis, voice quality average for each Eb/No range tested is shown. As shown, the Handset B outperformed the Handset A by 0.44 MOS points in the –2Eb/No condition.



	10	2	0	-2
Handset A	3.86	3.85	3.62	2.86
Handset B	3.89	3.85	3.76	3.30

In this analysis, voice quality standard deviation for each Eb/No range tested is shown. In order to maintain a consistent statistical confidence interval for each range tested, an increasing number of samples is required as the channel conditions are degraded.



	10	2	0	-2
Handset A	0.11	0.07	0.19	0.32
Handset B	0.05	0.12	0.16	0.29

Conclusions
Voice quality measurements can be used effectively to characterize and compare the performance of handsets under faded channel conditions in simulated network environment. Comparable to this test process, each codec may be tested including half-rate.