

## THE PRACTICAL ELECTRICAL ECHO MEASUREMENT FOR THE TECHNICAL INFORMATION SECURITY TASKS

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The abstracts present the results of practical measurements of the electrical echo delay during a telephone conversation. The purpose of the measurements is to find out how unique and suitable for identification are the channel characteristics for various types of telephone connections. Numerical results of the delays measurements in various communication channels under different conditions are presented.

The problem of measuring electrical echo (EE) for the problems of technical information security (TIS) was considered in [1]. The measuring signal for this problem was synthesized in [2]. Let's consider how the measurements were carried out and what practical results were obtained.

The measuring signal can be synthesized and reproduced by using a computer sound card. The problem arose - how to transfer this signal to the measured channel? Several methods have been considered:

- reproduce the signal through the external device located next to the microphone;
- make an electrical connection of the signal source with the telephone through the microphone input;
- synthesize the measuring signal in the phone directly.

The second way was chosen, as it is the simplest and provides good quality.

To match the inputs and outputs impedances, additional circuit elements were used.

The reflected EE signal was received and recorded using a computer sound card through an audio connector.

Both the transmitted and reflected signals were recorded by software, as shown in the fig., which simplified subsequent processing.

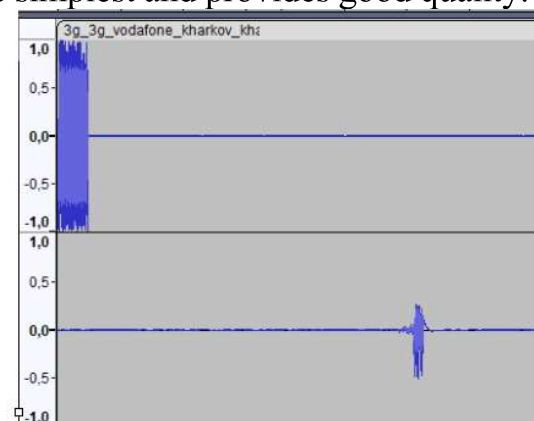


Fig. - Transmitted signal and EE signal

General measurement results.

1. The largest EE value occurs after the first and second pulses. In the future, the echo level decreases due to the echo suppression filters. Therefore, it can be argued that anti-echo filters significantly complicate measurements.

2. The EE signal returns with distortion, but generally retains the structure

and properties of the chirp signal. This makes it possible to carry out its correlation processing.

3. The EE delay in all cases was significantly greater than the values of 20 ... 200 ms presented in the literature.

Numerical results of measurements.

1. When connecting within the city and both subscribers are in a common mobile operator network, the EE delay was 723 ms, RMS 30 ms.

2. When connecting within the city and both subscribers are in the different mobile operator networks, the EE delay was 834 ms, RMS 25 ms.

3. When using a voice messenger between subscribers within the same city through a high-speed Internet connection and Wi-Fi termination, the EE was 1190 ms with an RMS of 102 ms.

4. The same conditions as (3), but using a VPN with packet forwarding through a foreign server, showed a delay of 1244 and RMS 200 ms.

5. When using a 4G (LTE) network and conditions (3) repeating, the delay was 1165, RMS 88 ms.

6. When using the 3G network and conditions (3) repeating, the delay was 1246 and RMS 310 ms.

7. In the case when one of the subscribers used the 2G network, the second used 3G network, and the conditions (3) were repeated, the delay turned out to be significantly higher - 1650 ms with an RMS of 185 ms.

8. When conditions (3) were repeated, but both subscribers were connected to the 2G network, then the delay increases even more and amounts to 2356 ms and RMS 284 ms.

The results obtained allow us to state that if the distance to the subscriber is known, then the EE delay shows the type of telecommunication connection that is used.

The further research direction may be the EE spectrum analysis, the analysis of the influence of the measuring signal level to the anti-echo devices operation, as well as the measuring signal development for hidden measurement of the electrical echo.

## References

1. Ovcharenko D.R., Khizhnyak P. P. About the possibilities of the electric echo use for the technical information security tasks. 27<sup>th</sup> International Forum of Young Scientists «Radio electronics and youth in the XXI century», V. 3. – P. XXX-XXX.

2. Ovcharenko D.R., Zakhanskaya V. E. Measuring signal for electric echo analysis for the technical information security tasks. 27<sup>th</sup> International Forum of Young Scientists «Radio electronics and youth in the XXI century», V. 3. – P. XXX-XXX.