

## **ANALYSIS OF THE PRACTICAL MEASUREMENT OF ELECTRICAL ECHO PARAMETERS IN MOBILE COMMUNICATIONS**

Ovcharenko D. R., Khizhnyak P.P.

Scientific supervisor – Dr. Sci., Prof. Antipov I. E.

Kharkiv National University of Radio Electronics, Dep. CRETISS

diana.naidonova@nure.ua

The results of practical measurements of echo signal delays during calls in the networks of mobile operators in Ukraine are presented. It is shown that with the help of electrical echo, facts of call redirection to the network of another operator can be detected, since the echo delay increases. It has been established that the use of a roaming SIM card will not allow simulating a stay in another country if it is registered in the network of the national telecom operator. The use of IP telephony when calling to mobile networks is also clearly determined by the echo delay.

In continuation of the work on analyzing the electrical echo (EE) parameters [1], for technical information security experimental studies were carried out. It is expected that measuring the echo delay will help more accurately identify an incoming call, and avoid fraud and spoofing.

During the experiment, measurements were made of echo delays for calls in the most common mobile networks in Ukraine: Kyivstar, Vodafone, and Life. Measurements were also taken for the Ukrtelecom wired network and the 3mob mobile network. The distance between subscribers also changed during experimental measurements.

If both subscribers were in the same operator network, the delay was 500...650 ms, and Kyivstar's delays were an average of 100 ms greater than Vodafone's. As the distance between subscribers increases, the delay increases too, but not significantly. Therefore, from the experiment data, it is difficult to determine whether the call originates from the same city, or from another city within Ukraine.

If subscribers were in the different operator's networks, the EE delay changed. So, when calling the Ukrtelecom wired network, it was less than 500 ms. In other cases, it was 100...200 ms longer than for calls within the network of one mobile operator. The delay is especially high when calling the 3mob operator network, where it reaches 1000 ms. Unfortunately, the spread of delay values does not make it possible to make an unambiguous conclusion about the subscriber's belonging to a particular network, as well as to determine its remoteness.

From an information security point of view, in some cases it may be of interest to answer the question: is the call forwarded? Is it possible to determine

the call forwarding by the EE delay? An experimental study showed that enabling call forwarding leads to a noticeable increase in EE delay than when calling the forwarded subscriber “directly”. This can be used to detect the fact of forwarding on the called party's side during an outgoing call.

It may also be of interest to ask what kind of delay there will be when using SIM cards of foreign mobile operators roaming in the country where the call is made. Experimental measurements showed that it does not affect the delay of EE in any way. It is within the same values that would be observed when using a SIM card of a national mobile operator for the corresponding direction. The conclusion that can be drawn from this measurement is that an attempt to simulate being abroad by using a SIM card from a foreign operator can be easily detected by measuring the echo delay.

The most effective measurement of EE is when identifying the fact of IP telephony use. This technology, together with “number spoofing,” is often used by telephone scammers to deceive their victims [2]. Such scammers often impersonate bank or law enforcement officials or fake the voices and phone numbers of relatives, etc. At the same time, the fraudsters themselves may be located in a foreign jurisdiction, beyond the reach of law enforcement agencies of their country. As the experiment showed, delays when making calls using the Skype-out function to mobile subscribers exceed 1500 ms. This is significantly more than for calls in any direction from any mobile operators in Ukraine. The identified difference practically eliminates the error.

The main results are graphically presented in Fig.

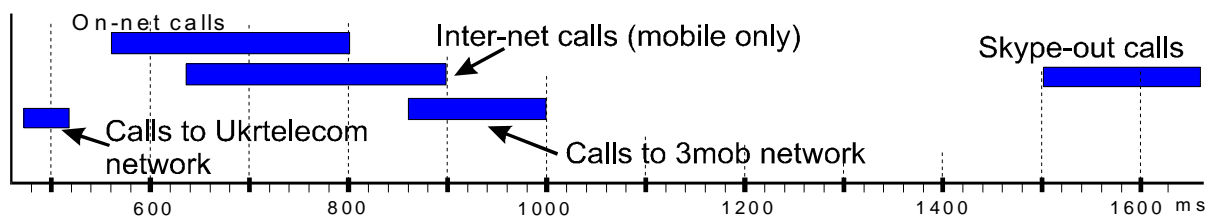


Fig. – Typical EE delays for different directions of calls

As a result of the experiment, it was shown that the delay electrical echo is an accurate indicator of IP-telephony use when calling a mobile phone. It can also be useful in detecting call forwarding and the subscriber being roaming.

#### List of References:

1. Ovcharenko D.R., Khizhnyak P.P. Measuring signal for electric echo analysis for the technical information security tasks // 27-й Міжнародний молодіжний форум «Радіоелектроніка та молодь у XXI столітті». Зб. матеріалів форуму. Т. 3. Харків. ХНУРЕ, 2023. С. 196–197
2. Найдёнова Д. Р. Защита клиентов банков от мошенничества путём подмены номера // XXIV Міжнародний молодіжний форум «Радіоелектроніка та молодь у XXI столітті». Зб. матеріалів форуму. Т. 3. Харків. ХНУРЕ, 2020. С. 118– 119.