Radioelectronics and Communications Systems
Vol. 49, No. 3, pp. 38–41, 2006

Izvestiya VUZ. Radioelektronika
Vol. 49, No. 3, pp. 51–57, 2006
UDC 621.396.6 : 623.624

A METHODICAL APPROACH TO ESTIMATING THE OPPORTUNITY FOR SUPPRESSION OF MOBILE UHF RADIO COMMUNICATION INSIDE BUILDINGS

V. B. Avdeyev and A. N. Katrusha

Military Institute of Radioelectronics, Voronezh, Russia

Based on the multicomponent model of radio wave propagation and probabilistic simulation of the situation with neutralizing the mobile UHF radio communication inside a building, a method is developed for assessment of opportunities for suppression, particularly, under conditions when the other party uses various techniques of radioelectronic protection from deliberate jamming, with regard for peculiarities of its propagation inside the building.

Suppression of mobile UHF radio communication, used by illegal armed formations, is an important task during preparation and execution of antiterrorist measures. Fulfillment of this task in urban conditions and, moreover, within a single building, has its own peculiar features, since the propagation of radio waves is multibeam in its nature. This leads to considerable changes in the signal and interference field levels (up to 30–50 dB) throughout a relatively small volume. Thus, in the event of blocking the communication receiver, the search for new positions, suitable for reception, may become an effective measure of protection from jamming.

It should be noted that statistical models of radio wave propagation, used in practice for estimation of suppression effectiveness (as well as for protection from suppression) [1–6], make it possible to calculate only the average levels of the signal and jamming fields. They cannot take account of deep fading arising from interference of waves in the reception point. One of such techniques for estimating the opportunities for suppression of mobile communication in urban conditions, based on a statistical model of radio wave propagation, is presented in [7]. The calculations with the aid of deterministic models of radio wave propagation [8, 9] are rather laborious. However, they allow for important "route" factors, which make a considerable impact on the field formation and, therefore, on reliability of estimation of suppression efficiency, particularly, in the zones of radio shadow, typical of reception conditions in urban localities and in buildings. Of course, such calculations demand for a large stock of initial data, for example, electric and geometric parameters of obstacles, reflectors, scatterers, etc., unacceptable in many cases. Moreover, people moving inside the building and in the vicinity of transmitting and receiving antennas may (as shown by experiments [6]), make their "contribution" in the levels of attenuation of UHF radio waves. As a result, spatial distributions of signals and jamming may vary even in the case of non-moving transmission and reception antennas. In addition, because of multibeamness we often cannot localize the working communication transmitter, and even determine its bearing to draw a probable family of communication radio routes.

Based on the above, it is expedient to use probabilistic parameters to characterize the effectiveness of suppression of mobile UHF radio communication. In this paper we present methods and results of assessment of opportunities for suppressing UHF radio communication based on the probabilistic model of suppression, and on the multicomponent model of radio wave propagation. The model was suggested in [10] and checked experimentally in [11].

REFERENCES

1. M. Hata, Empirical formula for propagation loss in land mobile services, IEEE Transactions on Vehicular Technology, Vol. 29, No. 3, pp. 317–325, 1980.

2. J. Walfish and H. L. Bertoni, IEEE Transactions on Antennas & Propagation, Vol. 36, No. 12, pp. 1788–1796, 1988.

3. F. Ikegami et al., IEEE Transactions on Antennas & Propagation, Vol. 39, No. 3, pp. 299–302, 1991.

4. Propagation data and prediction models for the planning of indoor radiocommunication systems and radiolocal area networks in the frequency range 900 MHz to 100 GHz. Draft new recommendation (Document 3/2) ITU Doc. 3/B1/1-E as of 19 February 1997 (to Recommendations ITU-R, p. 1238).

5. G. A. Ponomaryov, A. M. Kulikov, and Ye. D. Tel'pukhovskii, Propagation of UHF-Waves in a City [in Russian], "Rasko" small enterprise, Tomsk, 1991.

6. V. N. Troitskii and A. A. Shur, Elektrosvyaz', No. 8, pp. 26–29, 1998.

7. A. N. Bortnikov, A. V. Bubenshchikov, M. Ye. Zhilina, V. P. Pustovit, and A. D. Sorokin, Elektrosvyaz', No. 6, pp. 29–31, 2002.

8. W. Zhang, IEEE Transactions on Antennas & Propagation, Vol. 45, No. 11, pp. 1669–1678, 1997.

9. H.-W. Son and N.-H. Myung, IEEE Transactions on Antennas & Propagation, Vol. 47, No. 8, pp. 1344–1350, 1999.

10. V. B. Avdeyev, D. V. Avdeyeva, A. N. Katrusha, and G. V. Makarov, Izv. VUZ. Radioelektronika, Vol. 47, No. 3, pp. 70–76, 2004.

11. V. B. Avdeyev, A. N. Katrusha, and P. Ye. Kuznetsov, Telekommunikatsii, No. 5, pp. 25–27, 2005.

12. S. A. Vakin and L. I. Shustov, Principles of Radio Countermeasures and Radio Reconnaissance [in Russian], Sov. Radio, Moscow, 1968.

23. A. L. Drabkin and V. L. Zuzenko, Antenna-Feeder Devices [in Russian], Sov. Radio, Moscow, 1961.

7 December 2005