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EXTENSION OF THE N-OFDM METHOD TO THE CASE OF ORTHOGONALLY POLARIZED SIGNALS

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The paper considers a data transmission method in radio relay communication systems based on the use of nonorthogonal frequency discrete modulation (N-OFDM) of signals in combination with their orthogonal polarization. Synthesis of demodulation procedure of N-OFDM signals is conducted with regard for the presence of cross-polarization interference. In order to analyze the potentialities of the procedure synthesized, it is proposed to employ the well-known procedure of calculating the Cramer-Rao lower bound for variance of potentially achievable errors at measurement of quadrature components of signal amplitudes.

One of promising directions of development in radio relay systems is the use of orthogonal frequency discrete modulation (OFDM) for improving their traffic capacity. The method is widely used in WiMAX-networks and ensures communications at direct visibility ranges (tens of kilometers). Further development of this approach is the method of nonorthogonal frequency discrete modulation (N-OFDM) [1, 2] permitting to multiplex the spectral band occupied by the signal, to tune away adaptively from narrow-band interference, and effectively operate under conditions of the Doppler shift of carrier frequencies. However, the works on development of the N-OFDM method up till now have been conducted with respect to a single-type polarization of the signals radiated. On the other hand, the use of two orthogonal polarizations of radiation makes it possible to almost double the capacity of a radio link. Such solutions are already known for the OFDM method [3].

The purpose of this paper is to elaborate the N-OFDM method by using a dual-polarization signal with nonorthogonal carriers.

Particularly, the task of our investigation is to synthesize demodulation procedures of N-OFDM signals with regard for the impact of cross-polarization interference.

It is assumed that the principle of generation of dual polarized signal packet with nonorthogonal carriers in the transmitter is reduced to usage of two independent quadrature channels of digital-to-analog conversion, each loaded with its own radiator. The subcarriers undergo the quadrature-amplitude modulation (QAM) in accordance with the message transmitted. Reception of the signals is performed by a similar antenna with a polarization selector and subsequent quadrature analog-to-digital conversion in each of the polarization channels.

Demodulation of the signals is performed under the assumption that exact frequencies of subcarriers are known. In order to take the cross-polarization interference into account, adaptive reduction of the QAM-modulation level is applied. In this case, estimation of the level of cross-polarization components is conducted by pilot-signals radiated both from the transmitter to receiver and in the opposite direction.

The synthesis of demodulation procedure will be performed using the method of least squares. Assume that in the general case the radiation on orthogonal polarizations using the N-OFDM method is conducted at non-coinciding subcarriers, while the number of subcarriers themselves in different polarizations is the same. Assume also that the levels

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