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Estimation of Formalized Message Bringing in Broadband Channel Taking into Account Useful Signal Searching Time

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Abstract—It is estimated bringing time of formalized message in broadband channel, taking into account synchronization establishing time. We show, if signal to noise ratio is greater than four, a probability of correct information finishing at definite time is practically independent on information repetition number.

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Now broadband systems are applied for information transmission. searching signal stage is always present in broadband communication systems are, after this stage an information receive is possible. General questions of signal searching and information receive are considered in papers [1, 2]. Average time of information bringing is often use as a parameter of information bringing rate. But the most complete parameter is integral function of bringing time distribution, which defines probability of successful information bringing during definite time.

The purpose of this work is estimation of formalized message bringing time in broadband channel taking into account searching useful signal time.

The solution of task is obtained under following conditions: useful signal searching is realized by system of two step rotoring, searching process and information receive is realized in systems with given signal to noise ratio.

Since information receive is possible only in case of synchronization realization, probability density of information bringing time can be written as probability density of simultaneous distribution of two random values t_1, t_2 [3]:

$$f(t_1, t_2) = f_1(t_1) f_2(t_2 / t_1), \tag{1}$$

where t_1, t_2 are searching time and message receive time correspondingly, $f_1(t_1), f_2(t_2 / t_1)$ are probability density of signal searching time and conditional probability density of message receive time, correspondingly.

It is known [4–6] in some cases searching time can be approximated with reasonable accuracy by exponential distribution:

$$f_1(t_1) = \lambda \mathrm{e}^{-\lambda t_1}.$$

These conditions are satisfied when relation of mathematical expectation to mean square deviation of searching time is near one. Here $\lambda = 1/\bar{t}$; $\bar{t}$ is mathematical expectation of signal searching time, which is defined in dependence on noise situation. In case of Gaussian noise presence in channel it can be obtained in form of [5]:

$$\bar{t} = \frac{T_1}{D} + \frac{(N-1)(2-D)}{2D}(T_1 + FT_2),$$

where T_1 is definition element analysis time at the first step; T_2 is definition element analysis at the second step; F is probability of threshold crossing by Gaussian noise; N is number of definition elements; D is probability of threshold crossing by useful signal.