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An information transmission in the conditions of the adaptations of transmission information system to communication channel parameters

As it has been shown above, in real conditions information transfers a large role are played protective coding of information. Volume of final file, and accordingly, and time of transmission essentially depend both from chosen algorithm of the coding, and on quantity of errors which must be corrected for every code combination. During development of transfer protocol arises up exactly problems (to the choice of code algorithm with determination or with the correction of errors, and also determination quantity of errors, which need to be corrected). The choice of parameters with a supply often results often results in the uneffective use of channel. Proceeding from it is expedient to develop an algorithm which would allow correcting this ambiguity.

The specified problems directly linked from time of the use of information interchange channel. Except speed of transfer this parameter depends on length of a message of information (to volume of a file which should be transferred), lengths of the block of details what are transmitted, and quantities of errors which should be corrected:

$$t_k = \frac{N_e \cdot (L_e + K_e)}{\upsilon_k}, \quad (1)$$

where t_k – time of use of a communication channel, s;

L_e – length of an elementary message of information, bit;

K_e – quantity of control categories which are added to an elementary message of information, bit;

N_e – quantity of elementary messages which make a transmitted file;

x_k – speed of transmission, bit/s.

The comparative analysis of algorithms of construction of elementary messages taking into account quantity of control bits is already considered above. For modern transfer information system, which is built on the base of microprocessor means, the most widespread formats for protective codings is the byte or half-byte. The quantity of check bits what are added to information, does not depend on algorithm of the coding (Hemming, cyclic etc.), and is defined only by quantity of errors which should be corrected, and in the length of an elementary message of information. Thus, the basic problem is the choice most economic algorithm of the coding by a communication

channel operating time.

The use of microprocessor tools allows to divide the process of data preparation and process of transfer in time, spending at first the coding and, in case of need, repacking data, and then them transfer by a communication channel. It allows to liberate the channel for a while processed data on the transfer and reception sides.

If the algorithm of the coding with correction of errors is not used, and there is enough only their fixing, serial interfaces during data transformation time from a parallel code on successive are able to add the check bit of odd-even check without implementation of superfluous operations during preparation of information. For algorithms of the coding with correction of errors it is necessary to predict quantity of errors, which can arise up during transfer of elementary message. It can be carried out only after communication channel testing. In the literature [1] theoretical transfer of information are considered by a communication channel with hindrances and it is shown, that conditional entropy is:

$$H_y(x) = -\sum_{i,j} p(i,j) \cdot \log_2 p_i(j), \quad (2)$$

$$p_i(j) = \frac{p(i,j)}{\sum_j p(i,j)} \quad (3)$$

Also characterises the particle symbols, which are distorted hindrances during information transfer. Proceeding from it, it is expedient to realise device adaptation to transmission conditions so that depending on probability distortion signals and zeros to define quantity of errors, which is necessary to correct in the elementary message [2, 3, 4, 5].

Thus, stages of information transfer define sequence of operations:

- on the first testing of communication channel is carried out for what it transfers sequence of signals and zeros which is processed on the reception party, where middle probabilities of distortion of signals p_1 and zeros p_0 are determined, the results of calculations are passed to the transmitter;
- on the second stage the most effective algorithm of code is determined and preparation of information is carried out to the transfer process which, except for a protective coding, in the case of necessity contains and transformation of information to elementary message;
- on the third stage the transfer of information is carried out by a communication channel.

As well as the majority of microprocessor structures, the information transfer device can be built with use of a mode of programmatic exchange by information or a mode of interruptions. Both of them have certain advantages and lacks, but in this case it is expedient to use the second of them that the personal computer had possibility except function of information transfer to execute et al.

Process of exchange information by a classic structure, resulted on figure 1, it is expedient to execute in a few stages.

At the first stage communication channel testing is carried out. Thus the test sequence of signals and zeros for probability definition hindrances elementary binary signals is sent to a reception side. Signals transform after the proper law of modulation.

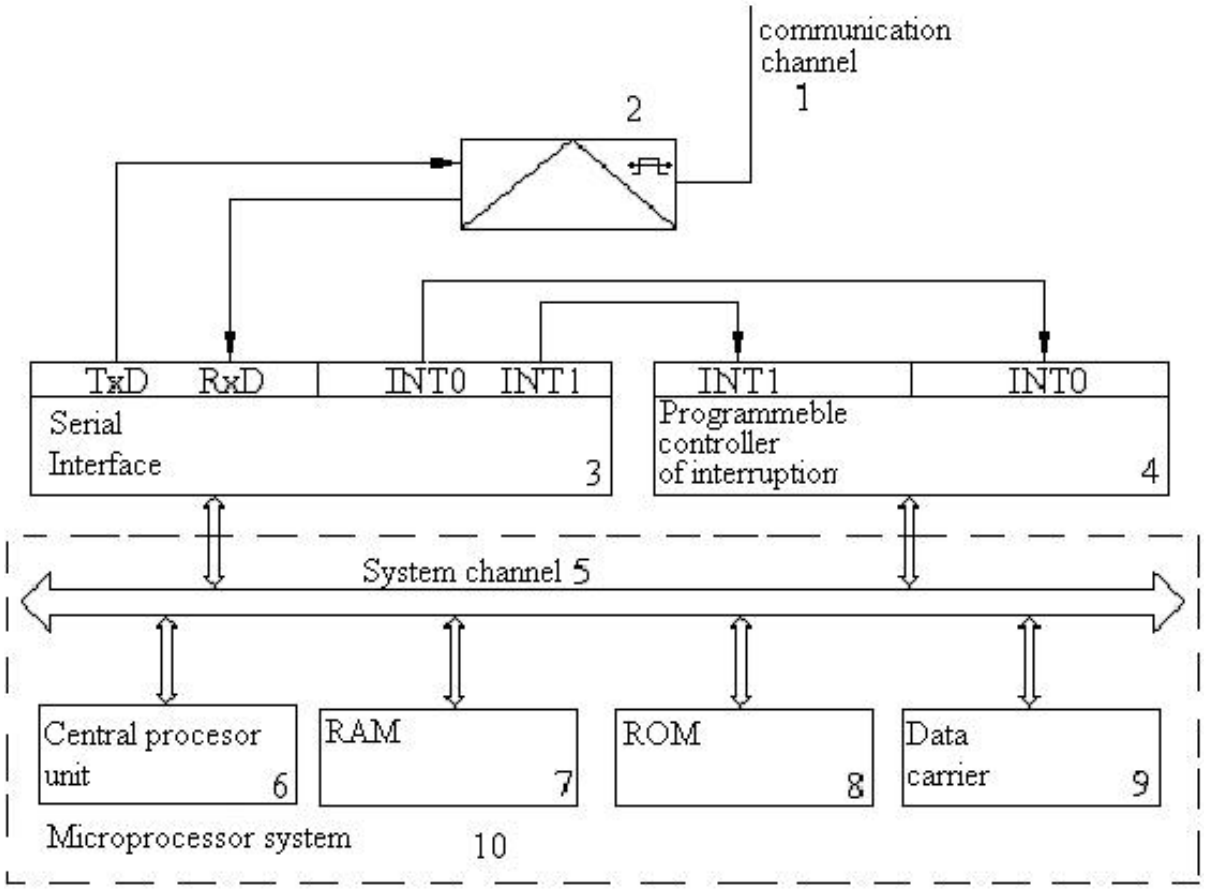

Figure 1. The generalised structure of realisation of method of information transfer with information adaptation

From a reception part the message on quantity of deformed signals and zeros proceeding from what it is possible to calculate probabilities of errors in a communication channel for signals p_1 and zeros p_0 that should be transferred, behind formulas arrives:

$$p_0 = \frac{N_{0.c}}{N_{0.\Sigma}}, \quad (4)$$

$$p_1 = \frac{N_{1.c}}{N_{1.\Sigma}}, \quad (5)$$

where $N_{0.C}$ and $N_{1.C}$ – accordingly quantity of zeros and signals of the test message which have been deformed by hindrances during information transfer by a communication channel;

$N_{0.}\text{In}$ and $N_{1.}\text{In}$ – accordingly quantity of zeros and signals in the test message.

The error on quantities of the information which is transferred by a communication channel, is equaled that part of this information, which is absent in the accepted signal, in other words, that uncertainty in relation of transmitted signal, which takes place when the accepted signal is known. Actually it will be defined middle entropy:

$$H_\xi = -\sum_i p_i \cdot \log_2 p_i. \quad (6)$$

Taking into account principles of formation of data in microprocessor systems, it is possible to consider them not correlated. Proceeding from the formula (6) entropy for signals H_1 and zero H_0 will make:

$$H_1 = -\left(p_1 \cdot \log_2 p_1 + (1 - p_1) \cdot \log_2 (1 - p_1)\right), \quad (7)$$

$$H_0 = -\left(p_0 \cdot \log_2 p_0 + (1 - p_0) \cdot \log_2 (1 - p_0)\right). \quad (8)$$

Calculated to entropy will show the particle of signals, which can be distorted during an information transfer. For simplification it is expedient to choose greater from them, getting a result with a supply:

$$H_\xi = \max\left(H_0, H_1\right). \quad (9)$$

The quantity of elementary signals which can be distorted hindrances during a transfer of communication channel, is:

$$\xi_\Sigma = n \cdot 8 \cdot H_\xi, \quad (10)$$

where n – volume of a file which should be transferred, byte.

Quantity of errors, what it is necessary to correct in each message, is:

$$\xi_p = \frac{\xi_\Sigma}{n \cdot 8} \cdot k, \qquad (11)$$

where k – quantity of information bits in each message.

Thus, at the first stage the quantity of information bits in each message, which can be distorted, are determined. For realization of code algorithm this parameter must be rounded off in a greater side to the integer:

$$s = \text{int}(\xi_p) + 1. \qquad (12)$$

On the second stage an algorithm gets out and the code of information is carried out in accordance with the chosen algorithm. If it is necessary to correct two errors, the transmission must be carried out half-bytes (four informative and nine check bits). If correcting is necessary one error, it is possible to transmit information half-bytes (four information and three control categories) or bytes (eight information and four control categories). The type of algorithm of the coding (Hemming, cyclic and so forth) has no principle value. But taking into account that consecutive interfaces carry out transmission only eight bits (if digits less than, they are complemented zeros), for time reduction of information transfer channel use after protective coding it is necessary to carry out transformation data, complementing insufficient to eight quantity of digits from a next byte.

At the third stage is carried out transfer of official messages relation algorithm of the coding (type and quantity of errors which are corrected) by an arbitration method. Thus the same message is transmitted a few times, and on a receiving side on receipt the most credible gets out on bits. After that, enters to the action the transmission of basic information.

The test message can be transmitted a few times on different speeds for the purpose of determination such on which distortion will be the least. Transmission of the results of processing from a receiving side to the transfer is expedient to carry out in the mode a reiteration with the majority decoding, when data are transferred odd quantity of times and the bit-by-bit comparison of code combinations is make for determination of correct.

If the channel is symmetric ($p_1 = p_0 = p$) calculation of conditional entropy does not cause the difficulties:

$$H_1(0) = H_0(1) = -p \cdot \log_2 p - (1-p) \cdot \log_2 (1-p). \qquad (13)$$

If the channel is asymmetrical, for calculation it is necessary to use greater from

the got probabilities. In principle, it is possible to count up quantity of signals and zeros in a file which must be transferred and precisely enough to calculate value of conditional entropy taking into account distortion zeros and signals for an asymmetrical channel. But, except large complication of calculations, the result will not be reliable as after carrying out protective coding the quantity of signals and zeros will change. For determination of eventual parameter of recommended approximate calculations it fully sufficiently.

After definition of conditional entropy it is possible to choose optimum length of the elementary message and to define the quantity of errors, which can arise after its transmission and which will need to be corrected.

As the communication channel is used during the enough limited time, hindrances in it can be considered as stationary casual process. Then the estimation of length of test sequence zeros and signals can be spent behind a method considered above.

The developed adaptive method allows to define necessary parameters for protective coding and to optimise information transfer process at the expense of the proved choice of quantity of errors which should be corrected, and reductions of time of the use of communication channel.

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