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Select noiseproof codes for information transmission lines collective

Download lines shared, and the first telephone network is constantly growing. Great information transmitted via modems with high level industrial noise, require efficient protocols and algorithms exchange related noiseproof encoding.

Messages must be transmitted to the communication line, consisting of information **P** and service **B** in parts

$$\mathbf{L} = \mathbf{P} + \mathbf{B}\ . \qquad (1)$$

The first one contains the information that is transmitted and the second – post office protocol, routing, etc.

Principle of the noiseproof coding is to build redundancy – the formation of additional control bits. Depending on the code distance d code can have different functionality

$$d = r + s + 1 \quad (r\ ^{3}\ s)\ , \qquad (2)$$

where r – number of errors identified;

s – number of errors corrected.

To correct one error code need a code with distance d = 3, and to correct two mistakes – with code distance d = 5.

So after noiseproof encoded message length **L** is increased by control bits **K**

$$\mathbf{M} = \mathbf{L} + \mathbf{К}\ . \qquad (3)$$

Often used block coding principle, when the original message is divided into L number of blocks L_1, L_2, L_3, … , L_n and each of them attached appropriate combination of control bits K_1, K_2, K_3, ..., K_n .

Because most of the lines of collective use of information transmitted using modems with PCs, then there are some features to consider:

Ä serial interface used to transfer information to the communication line, mostly working with bytes. Even if the number of bits can be programmed as for basis chip Intel 8251 (КР580ВВ51), the port can still follow the word with zeros to complete the communication line is transmitted 8 bits;

Ä to signals transmitted to the communication line can adversely affect the external factors that vary by season, time of day, weather conditions, congestion, lines, etc. and have a random character;

Ä using linear (sequential) code type Manchester II, AMI, BNZS, HDB3 so pointless, because they only fix bugs, not correcting them, require significant hardware costs and difficult program implemented;

Ä analysis of errors arising during transmission and not distort the information held, and hold it is necessary for each specific area separately based on individual characteristics of the network.

This led to what size unit code combinations practically defined.

Preliminary analysis of adopted information transmitted telephone network of Vinnitsa without noiseproof codes, showed that at speeds of 1200 and 2400 bps skewed a bit about a hundred. Use of the noiseproof codes (cyclic, Hemming etc.) requires an assessment number and the number of informative bits errors are corrected. The ratio of information and control bits for words of varying lengths given in tab. 1.

During the building code to correct two errors the number of control bits increases unreasonably, causing one of the major challenges for the delivery and on the other - increasing the probability of distortion of information.

The probability of accurate exchange of information considered for the simplest case (independence of errors that arise in a symmetric channel). The probability of error-free transmission will be determined:

$$p_{np} = 1 - p_{пом} . \qquad (4)$$

where the error probability.

Table 1 – Correlation of information and control bits

Word length	d = 3		d = 5	
	Number of control bits	The total number of bits	Number of control bits	The total number of bits
1	2	3		
2	3	5	4	6
3	3	6	5	8
4	3	7	9	13
5	4	9		
6	4	10		
7	4	11		
8	4	12		
9	4	13		
10	4	14		
11	4	15		
12	5	17		

For a system that uses the principle of error correction coding, the Bernoulli formula [1]

$$p_{np} = 1 - \sum_{i=k+1}^{m-1} C_m^i p_0^i (1 - p_0)^{m-1} - p_0^m , \qquad (5)$$

where the error probability;

k – number of errors corrected code;

m – total number of characters.

Another method [2] developed by L. Purtov,

$$p_{np} = 1 - \frac{m}{k} p_0 . \qquad (6)$$

The calculation results for both methods are tabulated in tab. 2. They show that already at eight characters method for determining the probability of the Bernoulli formula does not work because the error probability is much greater than one.

Table 2 – Probability of accurate information transfer for words of different length

<table>
<tr><th rowspan="2">Number of information bits</th><th rowspan="2">The total number of bits</th><th colspan="2">$d = 3$</th><th colspan="2">$d = 5$</th></tr>
<tr><th>For Bernoulli</th><th>For Purtov</th><th>For Bernoulli</th><th>For Purtov</th></tr>
<tr><td>1</td><td>3</td><td>0,99985</td><td>0,97</td><td></td><td></td></tr>
<tr><td>2</td><td>5</td><td>0,997</td><td>0,95</td><td>0,99993</td><td>0,985</td></tr>
<tr><td>3</td><td>6</td><td>0,983</td><td>0,94</td><td>0,89</td><td>0,96</td></tr>
<tr><td>4</td><td>7</td><td>0,88</td><td>0,93</td><td>Method does not work</td><td>0,935</td></tr>
<tr><td>5</td><td>9</td><td rowspan="7">Method does not work</td><td>0,91</td><td colspan="2" rowspan="7">Method does not work</td></tr>
<tr><td>6</td><td>10</td><td>0,9</td></tr>
<tr><td>7</td><td>11</td><td>0,89</td></tr>
<tr><td>8</td><td>12</td><td>0,88</td></tr>
<tr><td>9</td><td>13</td><td>0,87</td></tr>
<tr><td>10</td><td>14</td><td>0,86</td></tr>
<tr><td>11</td><td>15</td><td>0,85</td></tr>
</table>

12	17		0,83	

The calculations were carried out taking into account the previous analysis garbled probability The analysis confirms that the form code to correct two or more errors is pointless, because the probability of distortion due to increase in number of characters covers bug fixes.

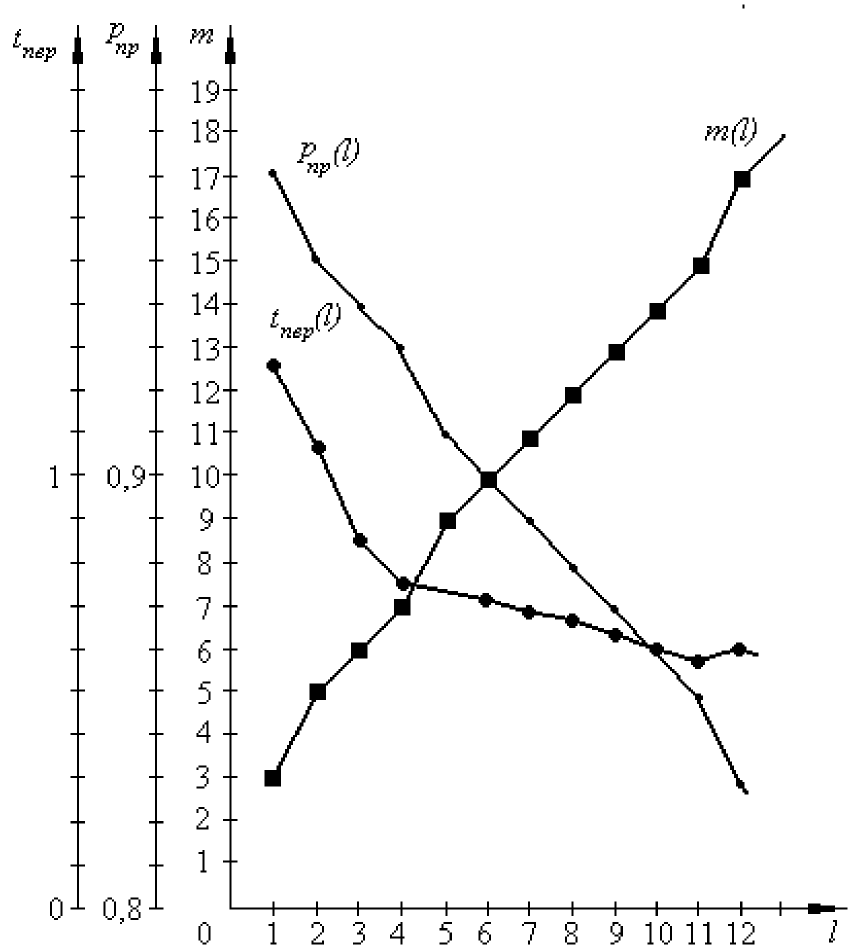
On the transfer efficiency significantly affect the exchange. In adverse conditions does not exceed the speed of 4800 bps, but actually is 2400 bps. To speed this time sending one kilobit (128 bytes of information) for words of different length with the principles of serial interfaces listed in the tab 3.

Table 3 – Time of transfer words varying lengths

Number of discharges	Transfer time, s (d = 3)	Number of discharges	Transfer time, s (d = 5)
1 + 2	1,7		
2 + 3	1,7	2 + 4	1,7
3 + 3	1,14	3 + 5	1,28
4 + 3	0,85	4 + 9	1,7
5 + 4	1,37		
6 + 4	1,14		
7 + 4	0,98		
8 + 4	0,85		
9 + 4	0,76		
10 + 4	0,68		
11 + 4	0,62		
12 + 5	0,98		

Table 4 – Time of transfer words of different length, provided re bytes

Number of discharges	Transfer time, s (d = 3)	Number of discharges	Transfer time, s (d = 5)
1 + 2	1,28		
2 + 3	1,07	2 + 4	1,28
3 + 3	0,85	3 + 5	1,14
4 + 3	0,75	4 + 9	1,39
5 + 4	0,77		
6 + 4	0,71		
7 + 4	0,67		
8 + 4	0,64		
9 + 4	0,62		
10 + 4	0,6		
11 + 4	0,58		
12 + 5	0,6		



Given the features of the serial interface to the appropriate transfer necessary the change information structure bytes, complementing the number and control bits to eight, adding the necessary amount from the next byte. At the same time transfer significantly reduced. The results of such calculations for similar conditions are given to the tab. 4. For illustrative graphs calculated parameters appropriate place in the same coordinate system.

Their analysis leads to certain conclusions:

ü for transmitting information necessary to build the code for correcting a mistake;

ü be the most efficient transmission by half bytes with the addition of three control to four bits of information;

ü before transmission necessary the change information structure, complementing the next level with up to eight bytes.

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