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EVALUATION OF THE EFFECTIVENESS OF CHANNEL LEVEL PROTOCOLL PARAMETERS

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Abstract: *There is justification for a simulation model for assessing channel level protocols. The effect of the data link layer protocol parameters on the data transfer function is analyzed. The data link protocol parameters have been specified and split into two categories, which are customizable and not configurable. In the work, parameters such as the acceptable information frame size are related in detail to the tunable data link protocol parameter; service personnel format; time-out value; unconfirmed frame window size, etc. That nominal data transfer rate, error-correcting codes used, etc. are non-configurable parameters.*

Key word: *channel level, protocol, parameter, frame, code, standby time, non-adjustable, error correction.*

INTRODUCTION. Different protocols are currently used to transmit data across communication channels. The list of the most common wired and wireless communication channel protocols is as continues to follow:

ARCNET, ATM, CDP, DCAP, Dynamic Trunking Protocol, Econet, FDDI, Frame Relay, HDLC, IEEE 802.11, IEEE 802.16, LocalTalc, L2F, L2TP, LAPD, LLDP, LLDP-MED, PPP, PPTP, Q.710, NDP, RPR, Shortest Path Bridging, SLIP, StartLAN, STP, VTP are supported. There is different efficiency in these protocols. We consider the features of IEEE 802.11b, which is one of the channel-level protocols, as we primarily focus on wireless data transmission. It is important to specify the protocol parameters, commonly called configurable parameters and non-configurable parameters, to evaluate the performance of the channel-level protocols.

The first case includes parameters of the protocol that can be updated or changed, including data and service duration, time-outs, etc. In the second case, for example, the parameters of the protocol are invariable: the nominal transmission rate, the use of codes resistant to interference (correction or detection codes). We will take a closer look at the tuning parameters (allowed frame rate, service staff format, time-out zoom, unconfirmed frame window size, etc.) of the channel-level protocols. Frame size has an important impact on the performance of protocols at the channel level. It is common for all channel-level protocols to increase the rate of data transfer with an increased frame rate. One of the most major factors affecting network performance is the permissible size of the information frame. As a rule, there are three types of staff transition across communication channels: standby, selective repetition and return to phase N [1, 2]. We consider the channel layer protocols' dependence on these modes. By increasing the size of the network, it is possible to increase the bandwidth.

Each of the "standby mode", "Step N", "Selective repetition" methods have their advantages and disadvantages according to the data environment, the type of data transmitted and the noise levels of the channels.

It is important to differentiate between nominal and actual data rates when setting up network channel protocols. The assured transfer of user data over time is real-time data transmission [3, 4].

Because of the prevalence of interference in the personnel and communication networks, as well as the pauses between individual workers, the real data transmission rate is lower than the nominal data rate.

METHODS. One of the essential roles of channel-level protocols is the computation network (EC-error control) and data flow (FC-flow control). Since the consistency of these criteria has a major influence on their efficiency. Current methods have been developed to assess the performance of channel-level protocols on the premise that no interference repair is possible for the data channels. The effect of staffing interruptions on the probability of staffing errors and the number of attempts to successfully move staff [5, 6] are addressed in this chapter.

The standby protocol implies that confirmation of receipt must be sent to each staff transferred. In the absence of clarification within a certain period of time, the workers correction shall be considered to be unacceptable and repeated [7-9].

We'll review the standby algorithm:

- The message source transmits the I (N) -code (data frame) and activates the timer (Figure 1).
- The receiver checks if I (N) personnel are not intact. In case of malfunction, a negative NAC receipt will be sent to the recipient. After receiving a negative receipt, the source removes the timer and again transmits the I (N) frame and activates the timer (Figure 2.4).
- The receiver checks if I (N) personnel are not intact. If the frame is not broken, the recipient will send a positive ASK receipt.
- The source waits for a specified time (time-out). If no positive receipt is received during this time (ASK disappears due to interruptions in the communication channel), the source will remove the timer and re-transmit this I (N) frame.
- If it happens several times in a row, the transmitter ceases to transmit the data and believes that the channel will be disrupted.

RESEARCH AND DISCUSSION. Time-out is an essential factor, with the correct option affecting the consistency of channel-level protocols. To avoid duplication, the time-outs should be small enough, because the sender will receive the receipt late, and when the time-out expires, the source will re-transmit the picture. This value might not, however, be too high-this may cause communication channels to wait for lost receipts for longer. Configurable parameters of the data link layer protocol are considered (permissible information frame size, service frame format, timeout value, window size of unacknowledged frames, etc.).

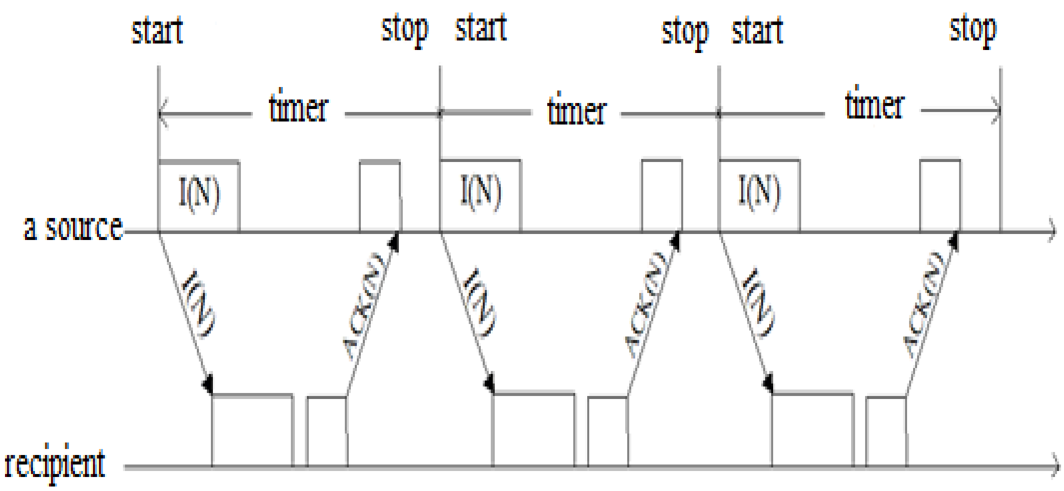

Figure 1. Standby mode scheme for corrupted state

Timeout is the standby algorithm parameter that most data works according to. The timeout determines the waiting time for the receipt. A functional scheme for selecting the parameters of the data transfer protocol has been developed based on the study of data transfer processes from the perspective of a device approach (Fig. 2.).

The influence of external factors on the knowledge transfer process is taken into account by the functional model: destructive external influences and the existence of interference in communication networks. The impact is taken into account by the functional model.

A system with an automatic retransmission request typically handles retransmissions or frame recovery. (ARQ request for Automatic Repeat).

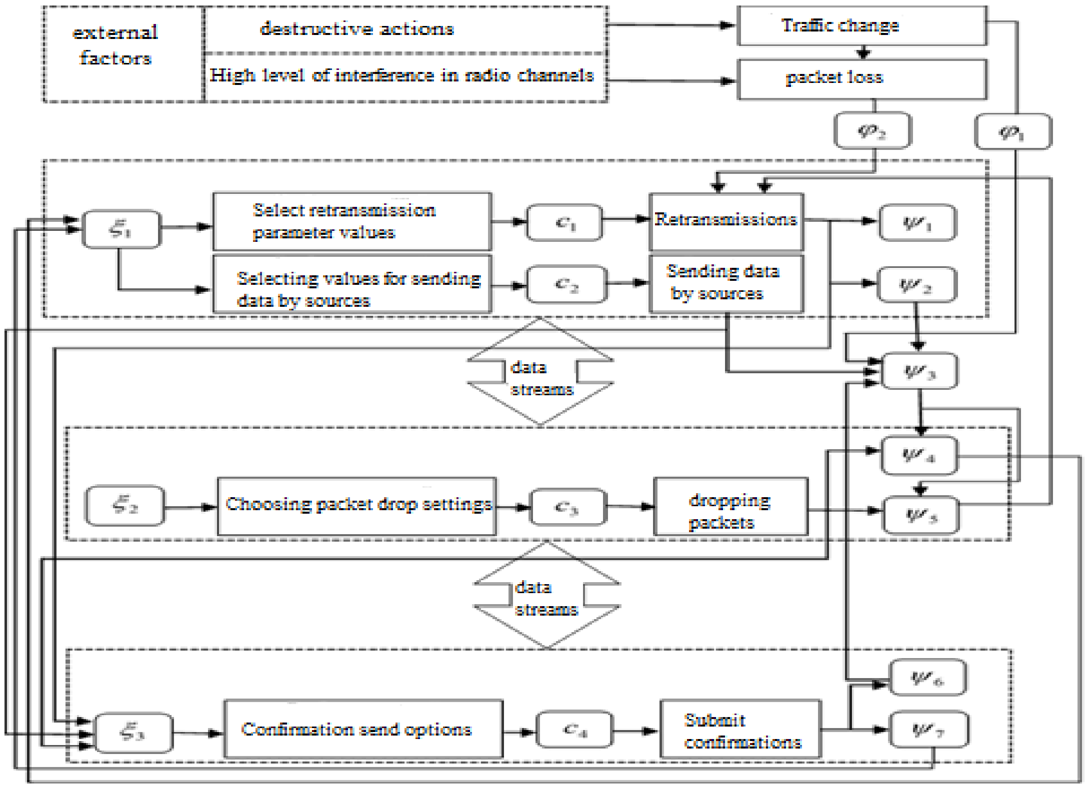

Figure 2. Functional diagram of the selection of packet data transmission parameter values.

The influence of the above external factors on the processes of packet data transfer takes into account the following values of the set Φ: φ_1 - the values characterizing the change in traffic due to the influence of external factors; φ_1 - values characterizing packet loss due to the influence of external factors. In the processes of packet data transmission, a set is used that includes the following input values: Ξ - values characterizing the intensity of packet arrival at transit nodes; ξ_2 - values characterizing the intensity of packet arrival at nodes - receivers.

The choice of parameter values for packet data is reduced to obtaining the following output values C: c_1 - timeout - retransmission; c_2 - delays in sending packets by source nodes; c_3 - the probability of dropping packets in transit nodes; c_4 - delays in sending acknowledgments by receiver nodes.

The following set of values Ψ (particular indicators) characterizes the efficiency of choosing the values of the parameters of packet transmission: ψ_1 - values characterizing the delay in sending packets associated with the expectation of confirmations; ψ_2 - values characterizing the intensity of retransmissions; ψ_3 - values characterizing the mismatch between the intensity of data sending by source nodes and the available network bandwidth; ψ_4 - values characterizing packet delays in the queues of transit nodes; ψ_5 - values characterizing packet loss caused by congestion in transit nodes; ψ_6 - values characterizing the intensity of transmission over a network of confirmations; ψ_7 - values characterizing delays in sending acknowledgments at receiving nodes. The values of $\psi_1, \psi_2, ..., \psi_7$ indicators depend on numerous factors: destructive effects; data distortion due to interference in the network channels; features of sending data by source nodes; features of the implementation of retransmissions; features of dropping packets in transit nodes; features of sending acknowledgments by receiving nodes. Due to the presence in the model under consideration of numerous complex and random relationships, it is not possible to identify and formalize patterns that accurately reflect the dependences of the desired output c_1, c_2, c_3 and c_4 values on the available values of the input quantities ξ_1, ξ_2 and ξ_3.

The developed functional model makes it possible to identify and formalize regularities that accurately reflect the dependences of the desired output quantities on the available values of the input values of the random random relationships variables.

In the article related, there are several approaches to organizing the process of exchanging positive and negative receipts: standby, return to N steps and selective repetition [10-12]. Return to N steps and selective repetition is carried out in the mechanism of the "sliding window", in which the source sends a certain number of frames without waiting for a receipt; the number of frames determines the size of the window [13, 14].

$$RTT = \frac{N}{R} + \frac{N_{kvit}}{R} + \frac{S}{R_{sig}} + 2 * T_k$$

where R is the nominal speed of the data link layer protocol; N - is the frame length; N_{kvit} - the number of bits in the receipt frame; S - is the length of the data channel; T_k - time interval between frames; $T_k = T_1 + T_2$ - time spent processing information; T_2 - time spent on processing the receipt; $R_{хисоб.сигнали}$ - signal propagation speed in the transmission medium; $R_{хисоб.сигнали} = c_0 \cdot \mu$, where c_0 is the signal propagation velocity in vacuum; μ - the ratio of the real speed of propagation of signals in a vacuum.

The article proposes the option of sending two receipts to increase the efficiency of the protocol, with the method of re-sending the personnel timer in case of an error or negative employment, that is, the timer expires[15,16]. When two positive receipts are sent to the recipient, there is a high probability that the first will receive the second incorrectly. In this case, the above formula adds the time required to send and receive the second quintile. In turn, as soon as the source correctly receives the first voucher, it starts sending the next and deletes it from memory based on the receipt of the second check. If the source receives the first voucher incorrectly or not, he will receive the second check before the timer expires.

The calculation of the time RTT for this case can be found in the following formula.

$$RTT = \frac{N}{R} + \frac{2 * N_k}{R} + \frac{S}{R_{sig}} + 2 * T_k$$

In standby mode, the frame source generates the next information frame into the channel only upon receipt of a positive or negative acknowledgment from the receiver, ACK or NAK, respectively. In the conditions of channel noise, to estimate the transmission time of an information frame, we introduce the real data rate V

$$V = \frac{N_{frame} - C}{T} * \rho$$

where N_{frame} is the frame length in bits, C - is the number of overhead bits in the frame, T - is the frame transmission time (including ASK),

$$T = D + \frac{N_{frame}}{R} + \frac{S}{R_{sig}} + T$$

that the channel delay D during the transmission of these overhead frames is generally determined by the expression

$$D = \frac{N_{\kappa}}{R} + \frac{S}{R_{sig}}$$

ρ - probability of unsuccessful frame transmission,

$$\rho = 1 - (1 - BER)^n$$

For technology Ethernet 10Base-T, you can find the optimal frame length by changing the frame size. The probability of creating a channel error bit is BER = 10-3 with a frame length of N = 161b. This is more than the smallest possible size of Ethernet technology. Similar parameters were found for similar technologies (Wi-Fi IEEE 802.11b, Token Ring, Frame Relay).

To calculate the real data transfer rate in the model, the N-step return method uses the formula, which has the form

$$V = \frac{(N_{frame} - C) * k}{T_{frame}} p$$

The actual channel speed using the method of selective repetition taking into account the length of the transmission channel is determined by the following initial conditions. The input parameters are defined as: C = 20 bytes, N_{frame} = 1100 bytes, NACK = 72 bytes, R = 10 Mb / s, BER = 10-6, R_{sig} = 1.98 * 108 meters/s.

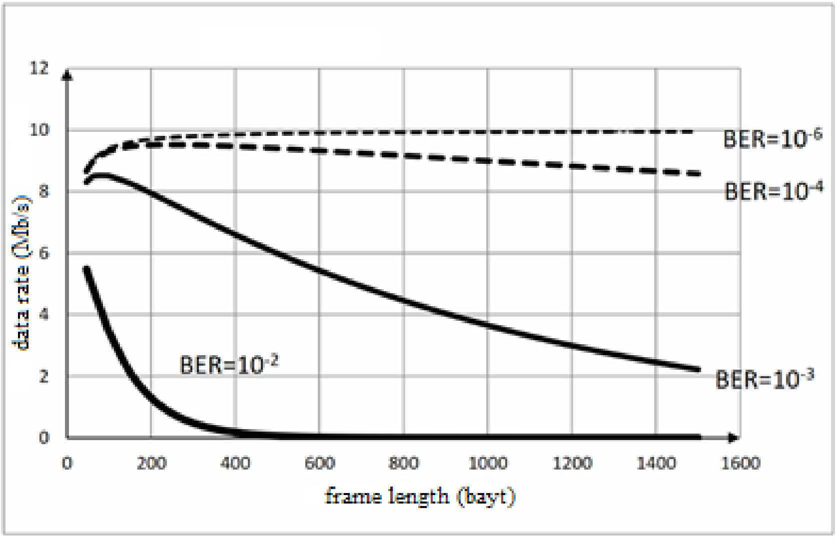

Figure - 3. Various BER real link speeds on Ethernet dependency on staff for values

CONCLUSION. On the basis of the results of the calculation, it can be concluded that the method of waiting for data transfer at low values and returning to phase N is preferred for high BER values, but using the selective iteration method allows the best result to be obtained, but the buffer size and processing power must be taken into account. On this basis, a system for all data transfer rate calculation methods, such as standby mode, N return mode, selector repeat mode, staff size and communication channel interference, has been developed. It also suggests selecting a timer for various methods of data transfer.

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