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Decision-making supporting algorithm for choosing the duration of the audio communication session in a mobile ad-hoc network

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ABSTRACT

The article presents the research results on the development of the decision-making support algorithm for choosing the duration of audio communication sessions, which allows transmission of audio streams with a given quality level in a mobile ad-hoc network.The recommended communication session duration depends on the limiting number of packets in the audio stream, which is calculated based on the mathematical models, which describes the average volume of a multimedia message which can be transmitted in the given network parameters with the required quality. The proposed algorithm implementation will allow the ad-hoc node to display a message about the recommended audio communication session length.
KEYWORDS: decision-making supporting algorithm, duration of the audio communication session, mobile ad-hoc network.

Algoritmo de soporte para la toma de decisiones al elegir la duración de la sesión de comunicación de audio en una red móvil ad-hoc

RESUMEN

El artículo presenta los resultados de la investigación sobre el desarrollo del algoritmo de soporte de toma de decisiones para elegir la duración de las sesiones de comunicación de audio, que permite la transmisión de secuencias de audio con un nivel de calidad dado en una red móvil ad-hoc. La duración recomendada de la sesión de comunicación depende del número límite de paquetes en la secuencia de audio, que se calcula en función de los modelos matemáticos, que describe el volumen promedio de un mensaje multimedia que se puede transmitir en los parámetros de red dados con la calidad requerida. La implementación del algoritmo propuesto permitirá que el nodo ad-hoc muestre un mensaje sobre la duración recomendada de la sesión de comunicación de audio.
PALABRAS CLAVE: algoritmo de soporte para la toma de decisiones, duración de la sesión de comunicación de audio, red móvil ad-hoc.

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Introduction

In the process of conducting search and rescue operations and emergency situations countermeasures, the great importance acquires the forces and means management organization through the provision of effective information exchange. At the same time, tasks are often carried out under the conditions of an inoperable (damaged) or missing telecommunications infrastructure and possible destructive external influences (Cheong et al., 2011; Polshchykov et al., 2017a). To transfer information in such situations, it is preferable to deploy a mobile ad-hoc network (MANET), which is capable of operating without base stations and has an arbitrary decentralized topology (Basagni et al., 2004; Polshchykov et al., 2018a).

MANET belongs to the class of packet data networks. With the packet transmission of audio streams, slight losses of individual packets are allowed. Lost voice information can be recovered using an approximation based on previous and subsequent data. However, significant packet loss cannot be recovered using this method. This leads to an unacceptable reduction in audio communication quality (Polshchykov et al., 2017b; Konstantinov et al., 2017).

The main causes of packet loss in MANET are network nodes random movement, their on and off switching, as well as the bit errors occur due to the low power of transmitting devices. Under conditions of significant packet loss, it is recommended to limit the length of transmitted messages or reduce the length of audio streaming sessions.

The purpose of the research presented in the article is to provide the choice of the audio communication sessions duration, with which it is possible to transfer an audio stream with a given quality level in a MANET. To achieve this goal, it is required to develop a decision-making supporting algorithm on the choice of audio streams transmission duration in a mobile ad-hoc network.

1. Task assessment

Assume that the audio stream consisting of α packets is transmitted with acceptable quality if no packets were lost in the delivery process or the data of all lost packets were successfully restored. In this case, to recover the loss of one packet at the

receiving node, you need to get at least βprevious packets and at leastβsubsequent packets. Also, are given the following values:

*P*isthe required probability of audio stream transmitting with acceptable quality;

*L*ispacket bit length;

*C*isinformation bit rate;

t is required to develop an algorithm for choosing the valueτisthe duration of the audio stream transmission.

2. Algorithm Development

The audio stream transmission duration depends on the value α – the number of packets in a stream. The following expression can be used to calculate the valueτ:

$$\tau = \frac{\alpha L}{C}. \tag{1}$$

There commended value o fα can be obtained based on the mathematical models, which describes the average volume of a multimedia message which can be transmitted with the required quality with the specified operation characteristics of the MANET (Polshchykov et al., 2018b):

$$P = \sum_{b=0}^{c} k_{\alpha,b} \cdot p^{\alpha-\beta} \cdot q^{b}, \tag{2}$$

where q – is the packet loss probability in the process of an audio stream transmitting; $\alpha = \beta \ldots \infty; \alpha \in N; \quad \beta \in N$;

$$p = 1 - q; \tag{3}$$

$$c = \left\lceil \frac{\alpha - 2\beta}{\beta + 1} \right\rceil; \tag{4}$$

$$k_{\alpha,0} = 1; \tag{5}$$

$$k_{\alpha,1} = \begin{cases} 0, & \alpha \le 2\beta; \\ \alpha - 2\beta, & \alpha > 2\beta; \end{cases} \tag{6}$$

$$k_{\alpha,2} = \begin{cases} 0, & \alpha \le 3\beta + 1; \\ \sum\limits_{i=2\beta+1}^{\alpha-(b+1)} k_{i,b-1}, & \alpha > 3\beta + 1. \end{cases} \tag{7}$$

By performing calculations using expressions (2) – (7), it is possible to create a relational database containing the recommended values of $\alpha$for different values of β, $q$and$P$.Table 1 presents an example of the fragment of the specified database.

Table1 – Values of αat β=2

q	P				
	...	0,85	0,86	0,87	...
...	...	...	...	...	...
0,028	...	38	30	22	...
...	...	...	...	...	...
0,030	...	30	22	16	...
...	...	...	...	...	...
0,032	...	22	16	10	...
...	...	...	...	...	...

The value of the packet loss probability can be calculated by the formula:

$$q = \frac{K_{loss}}{K_{sum}}, \tag{8}$$

where K_{loss} is the number of packets lost during the specified observation period; K_{sum} – the total number of packets received by the node during the specified observation period.

3. Algorithm scheme

Fig. 1 shows a scheme of the desicion-making supporting algorithm for choosing the duration of an audio communication session in a MANET (Verma and Chauhan, 2015).

The following notation is used in the algorithm scheme:

$i$isthe received packet sequence number;

n_i isnumber in the stream of i-th received packet.

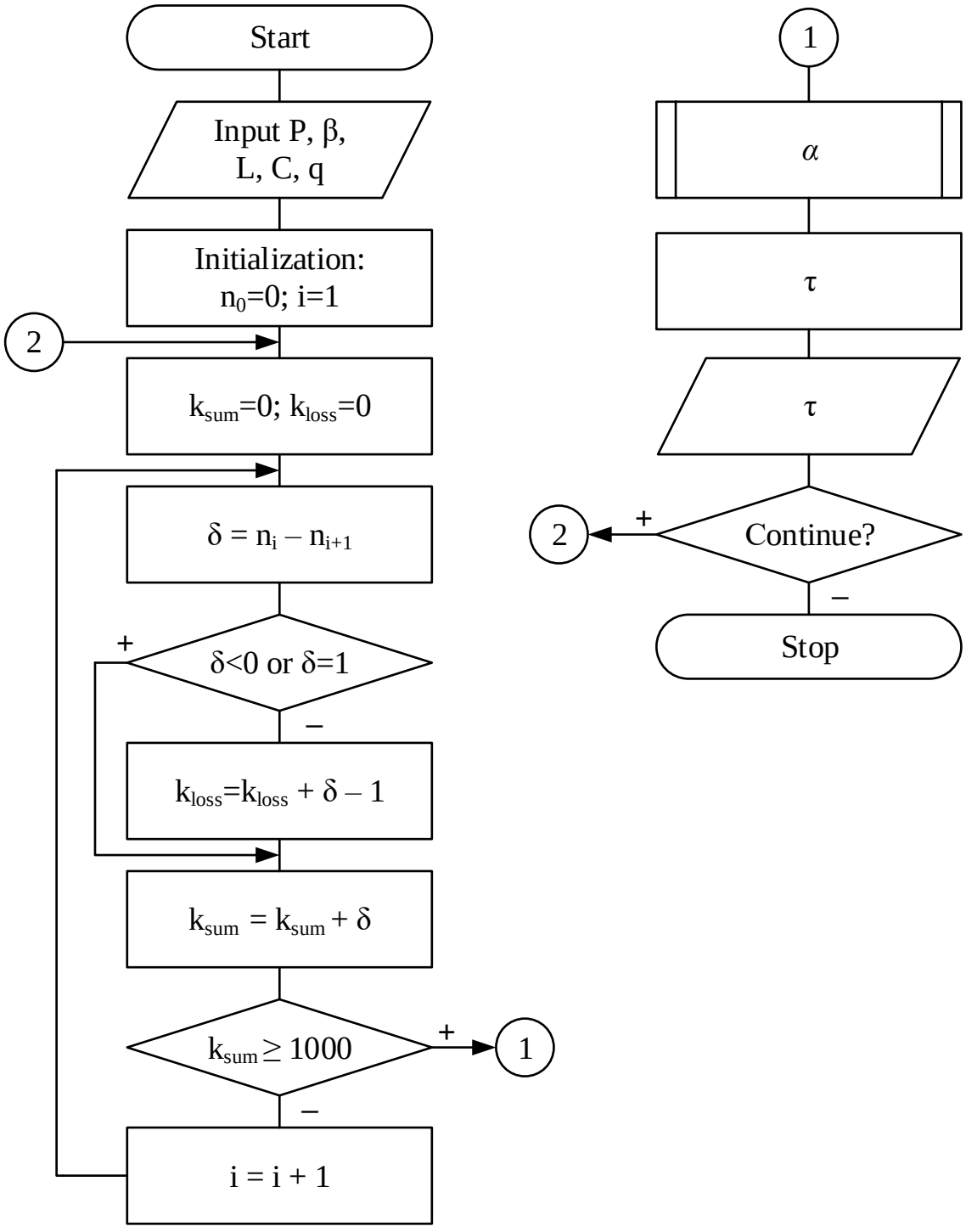

Fig. 1 – Scheme of the algorithm

As a result of the algorithm execution, the message with the recommended length of the audio communication session will be displayed on the ad-hoc node screen.

Conclusion

Thus, in the article was developed an algorithm for estimating the recommended duration of audio stream transmission in a MANET.The calculation of this value is based on mathematical models, which allow obtaining the value of packets number with which the audio communication session will be carried out with acceptable quality.

The direction of further research will be the development of software for implementing the proposed algorithm and obtaining experimental results.

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References

Cheong S.H., Lee K.I., Si Y.W., U L.H., (2011). Lifeline: Emergency Ad Hoc Network. Proc. of 7th International Conference "Computational Intelligence and Security (CIS)". Hainan: 283–289.

Basagni S., Conti M., Giordano S., Stojmenovic I., (2004). Mobile Ad Hoc Networking. IEEE Press, 461.

Konstantinov I.S., Polshchykov K.O., Lazarev S.A., Zdorovtsov A.D., (2017). Mathematical Models for Estimating Radio Channels Utilization When Transmitting Real-Time Flows in Mobile Ad Hoc Network. Journal of Fundamental and Applied Sciences, 9(2S): 1510–1517.

Polshchykov K., Lazarev S., Zdorovtsov A., (2017 b). Multimedia Messages Transmission Modeling in a Mobile Ad Hoc Network. Proc. of the 11th International Conference on Application of Information and Communication Technologies (AICT). Moscow: 24–27.

Polshchykov K.O., Lazarev S.A., Zdorovtsov A.D., (2017 a). Neuro-fuzzy control of data sending in a mobile ad hoc network. Journal of Fundamental and Applied Sciences, 9(2S), 1494–1501.

Polshchykov K.A., Lazarev S.A., Zdorovtsov A.D., (2018 a). Evaluation of channel accessibility waiting period prediction channel to transmit real-time streams in mobile ad hoc network. Journal of Advanced Research in Dynamical and Control Systems, 10 (4): 1460–1467.

Polshchykov K.O., Lazarev S.A., Kiseleva E.D., (2018 b). Mathematical Model of Multimedia Information Exchange in Real Time Within a Mobile Ad Hoc Network. International Journal of Computer Science and Network Security, 18 (6): 20–24.

Verma H., Chauhan N., (2015). MANET based emergency communication system for natural disasters. Proc. of International Conference "Computing, Communications & Automation (ICCCA)". Noida: 480–485.