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ОПРЕДЕЛЕНИЕ КОЛИЧЕСТВА КОПИЙ ДАННЫХ, ОБЕСПЕЧИВАЮЩЕЕ ИХ НАДЕЖНОЕ ХРАНЕНИЕ В ДЕЦЕНТРАЛИЗОВАННОЙ СЕТИ

DETERMINING THE NUMBER OF COPIES OF DATA, ENSURING THEIR RELIABLE STORAGE IN A DECENTRALIZED NETWORK

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Аннотация. В данной статье рассмотрено определение количества копий данных, обеспечивающее их надежное хранение в децентрализованной сети.

Одноранговая, децентрализованная или пиринговая сеть — оверлейная компьютерная сеть, основанная на равноправии участников. Часто в такой сети отсутствуют выделенные серверы, а каждый узел как является клиентом, так и выполняет функции сервера. В отличие от архитектуры клиент-сервера,

такая организация позволяет сохранять работоспособность сети при любом количестве и любом сочетании доступных узлов

Annotation. This article discusses the determination of the number of copies of data that ensures their reliable storage in a decentralized network.

Peer—to-peer, decentralized or peer-to-peer network is an overlay computer network based on the equality of participants. Often there are no dedicated servers in such a network, and each node is both a client and performs server functions. Unlike the client-server architecture, such an organization allows you to maintain the network operability with any number and any combination of available nodes

Ключевые слова: копии данных, децентрализованная сеть, хранение данных.

Keywords: data copies, decentralized network, data storage.

The number of copies of a file in a decentralized system is an important factor in the reliability of its storage and transmission.

The network consists of N participants, each digital resource is stored in the form of m blocks and k copies [1].

The number of copies of k directly affects the amount of information stored and the reliability of its storage. Obviously, the maximum reliability of data storage is achieved at k = N, but to achieve this result, it is necessary that each participant of a decentralized network stores all copies of all files that are in it.

At the same time, the maximum volume of the network will be determined by the minimum disk space of each participant, which in the future will limit its volume to several terabytes.

At the same time, if only 50% of the participants have copies of files, the network capacity can be doubled.

Therefore, solving the problem of determining the optimal k will allow achieving a balance between the volume of redundant data and the reliability of their storage [2].

The AnyLogic 8 system [3] was used for modeling, which allows building models of various processes and systems. Agent-based modeling was used to study packet transmission over the network.

Four variants of the k and N ratios were considered:

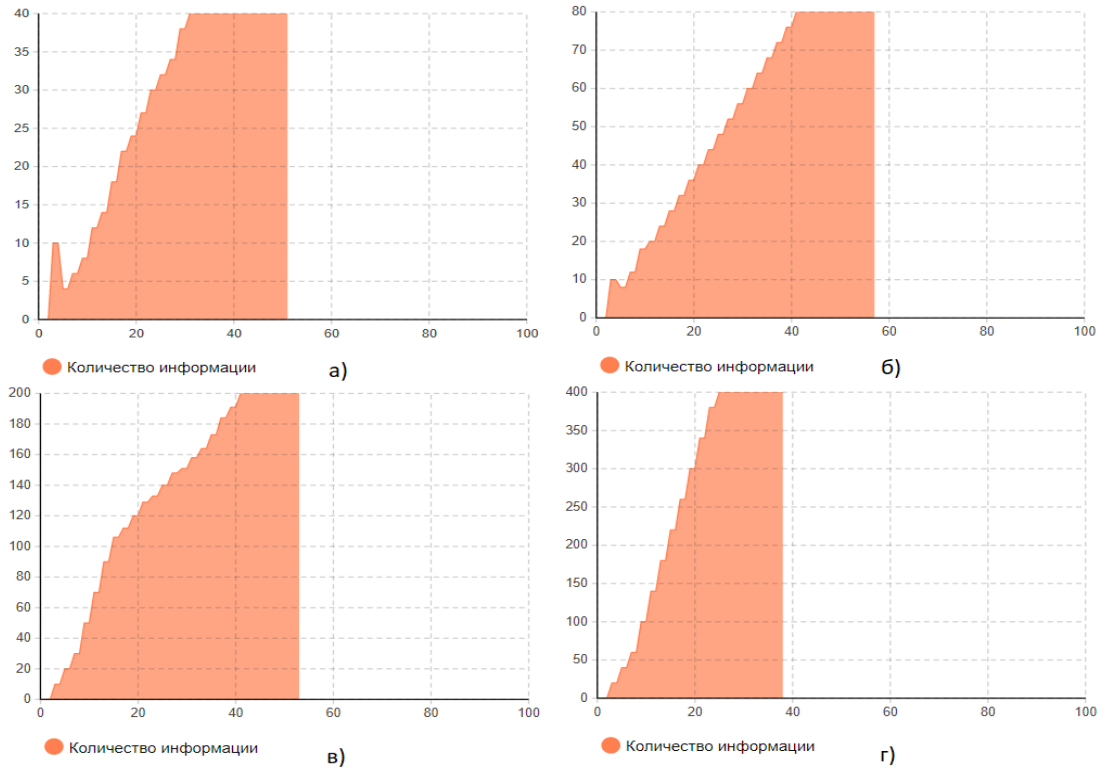
а) k = N ▪ 10%,

б) k = N · 20%,

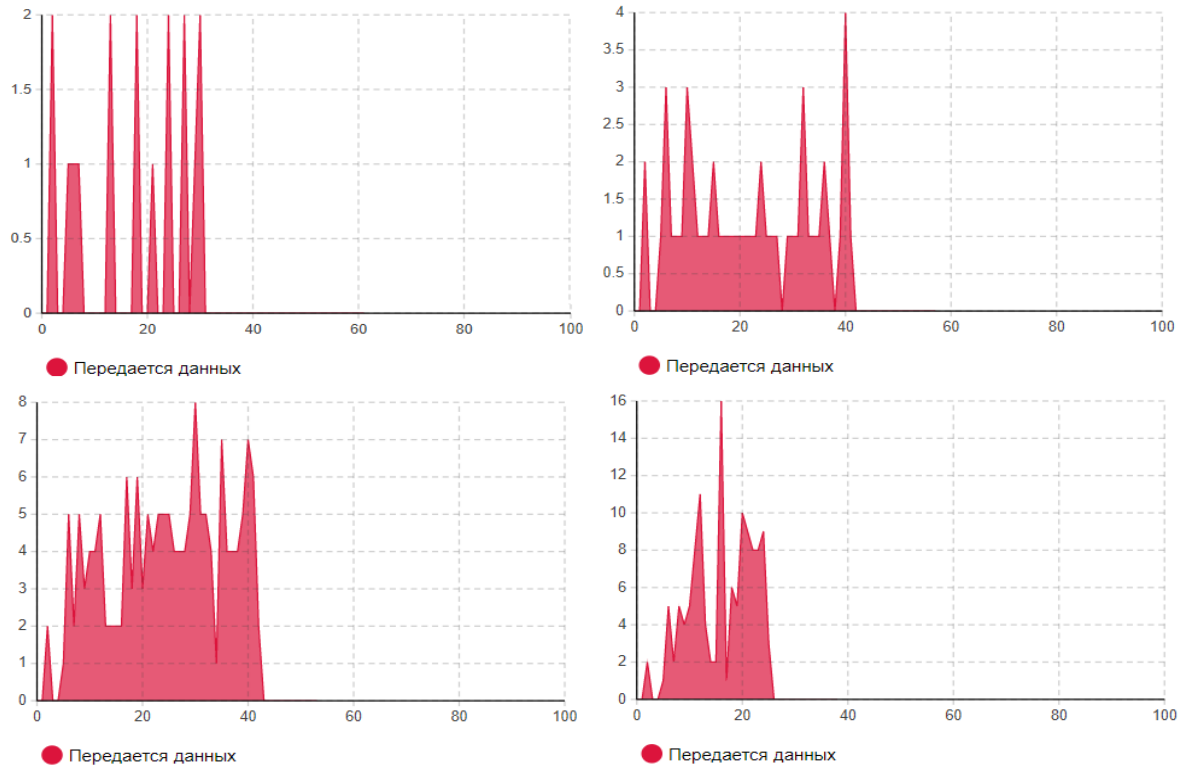
в) k = N · 50%,

г) k = N.

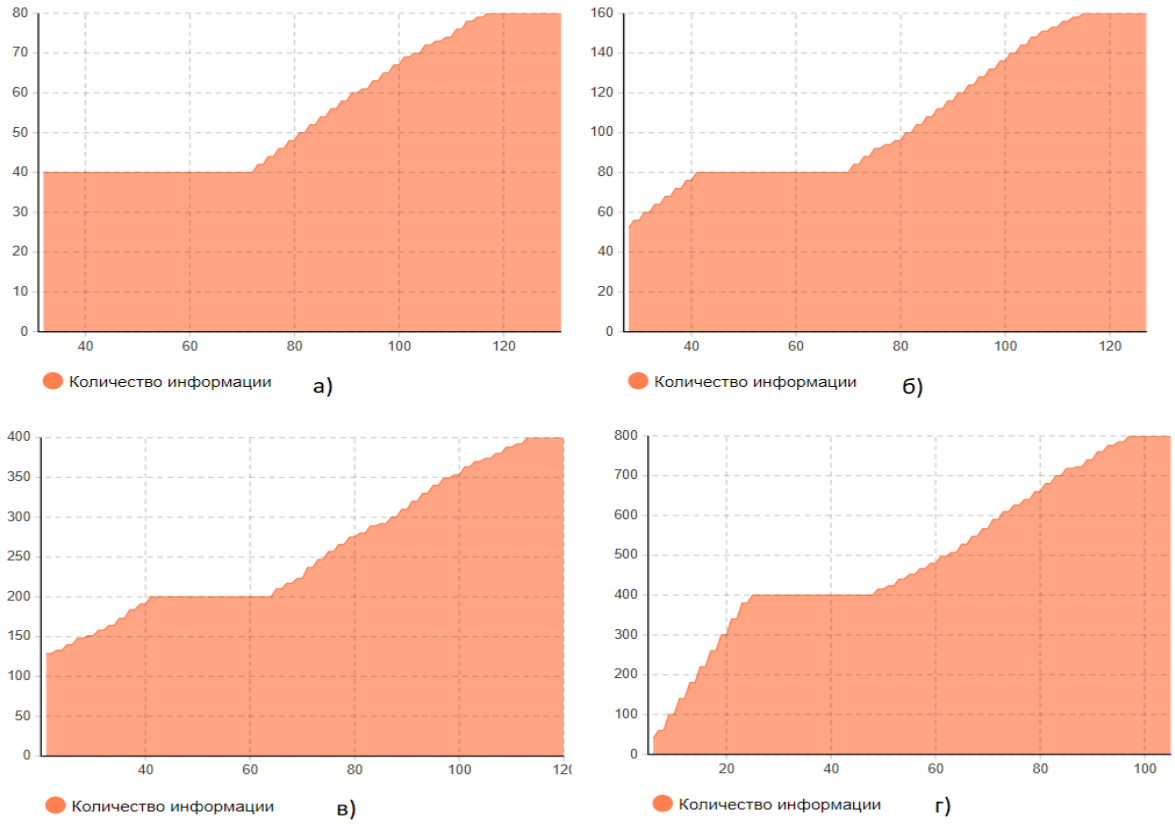
The simulation results are presented in Picture 1-5.



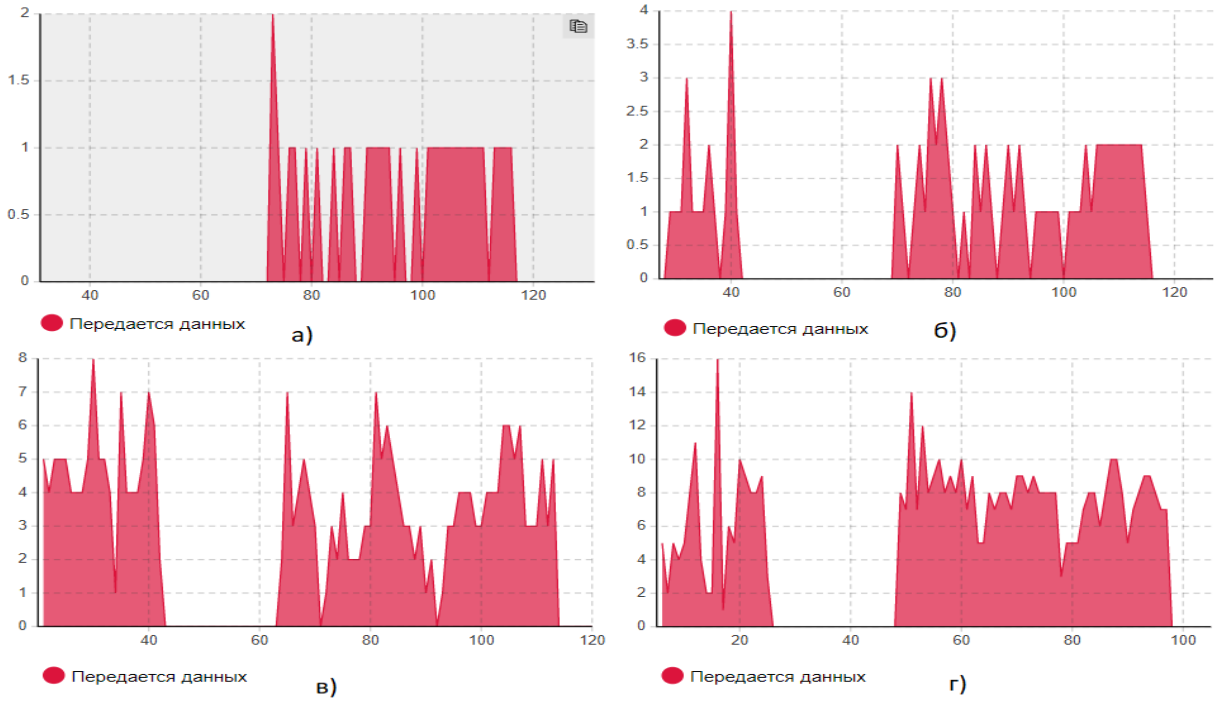
Picture 1 – Modeling the start of the system



Picture 2 – The amount of data transmitted at the beginning of the system operation



Picture 3 – Simulation of the system operation with the addition of 100% new nodes (doubling expansion)



Picture 4 – Data transfer when adding 100% new nodes



Picture 5 – Simulation of recovery after failure of 50% of nodes

The results presented in Figures 1-5 are summarized in Table 1.

Table 1 – Simulation results

	k = N · 10% (а)	k = N · 20% (б)	k = N · 50% (в)	k = N (г)
Getting started with the system				
Amount of information	40	80	200	400
Data exchange time	30	42	42	28
Adding 100% new nodes (doubling expansion)				
Amount of information	80	160	400	800
Data exchange time	42	45	49	44
Recovery after failure of 50% of nodes				
Amount of information	40	80	200	400
Data exchange time	50	40	15	-

Conclusions on the work

Analyzing the data in Table 1, we can say that the advantages of a peer-to-peer network implementing a point-to-point connection are fully disclosed with the maximum number of stored copies, k = N (d).

At the beginning of the system, the necessary information was transmitted the fastest at k = N.

The expansion of the system in all cases took about the same time, but the amount of information in option (d) is 10 times more than in option (a) and 2 times more than in option (b).

Also, a useful property of the system, which manifests itself only when the number of stored copies is k = N, is the absence of the need to redistribute them between the remaining nodes after the failure of part of the network, which has a positive effect on the reliability of storage.

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