Survivability Assessment of Distributed Information and Telecommunication Networks

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***Abstract*—The methods are applicable upon comparative assessment of distributed information-telecommunication networks as to their ability to provide information exchange between correspondents in conditions of occasional and intentional (computer attacks, using of the software's undeclared capabilities) software interferences (destructive software impacts). Impact of occasional and intentional interferences causing occurrence of failure chains on the network has been described in the network degradation model based on the percolation theory. The result of using of the methods is increase of reliability of assessment of structures of distributed integrated information-telecommunication networks upon variation of the quantity of communication nodes and lines of the network. Provision of adaptation capabilities of networks in conditions of impact of destabilizing environmental factors is achieved by selection of the best (from the number of admissible alternatives) network structure, as well as by selection of the best solutions for restoration of the communication between the transit nodes. The methods account security of communication lines, which, unlike the communication nodes, cannot be isolated from impacts of the environment.**

Keywords*—information security; networks; routing; adaptation; network security tools; network intelligence gathering; intentional interferences; percolation

I. Introduction

Occasional and intentional software interferences are disturbances reducing the quality of distributed integrated information and telecommunication networks (ITNs): real data transfer rate (availability of redundancy of the service information contained in each of fragments of message batches reduces the real data transfer rate) and availability of communication means (failure in maintenance of information systems) by creation of an abnormal additional load on processes and devices realizing them [1].

Survivability of the system is its ability to perform main functions despite action of disturbances [2].

Correspondents exercise information exchange between the protected ITN segments via a sequence of transit communication nodes and lines of the public-use communication networks (PUCN). At that the ITN structure, including all alternatives of routes of message batches between the corresponding users, is formed dynamically [3].

A task of the integrated assessment of the quality of subsystems fully or partially not belonging to the assessor arise. The given task is stipulated by using for information exchange of large and dynamic integrated ITNs, virtually unpredictably including one highly-reliable elements (nodes and connections between them functioning in the normal mode) and excluding the other ones. I.e. the task of assessment shall be resolved in the process of ITN structuring – constant alternation of its topology and typology of its elements [4, 5, 6].

Real ITN structures are rather large, therefore the task of assessment of survivability of ITNs cannot be resolved by analytical methods. In this connection it is customary [7, 8, 9, 10, 11, 12] to settle such tasks with the help of the imitation modeling.

Shortages of well-known methods of PUCN assessment put into practice are as follows:

narrowness of the area of application expressed in using of the local adaptation (coverage of specific fragments by adjustment) to variations of the structure and the quality of network resources upon selection of the route of passing of information messages;

insufficiently high reliability of results of assessment of ITN structures upon increase of the number of communication nodes and lines (at the same time the methods free from the given shortage are applicable only for communication nodes and lines (structures) taken as the endless ones as to the number of elements).

Low accuracy of the methods is stipulated by the following:

decentralized adjustment of routes;

unacceptable time and resource expenditures for receipt of the initial data on the large number of ITN elements;

combinatorial complexity of the task of search of safe routes on the large number of ITN elements;

unacceptably low sensitivity of route safety indexes connected with the fact that increase of the number of ITN elements will inevitably result in increase of the number of routes with the close value of the safety index;

absence of accounting of safety of communication lines, which, unlike the communication nodes, cannot be isolated from impacts of the environment, as they are not localized within the limits of the controlled zones. Compromise of the communication line is possible by placement of passive means of the malefactor on communication lines or by radio-electronic suppression of long-length communication lines, which will require significant means for search and elimination of reasons of reduction of values of complex safety indexes of communication lines.

The goal of the methods is resolution of the task of comparative assessment of ITN survivability providing increase of reliability of results of assessment upon variation of the number of communication nodes and lines of ITNs from the structures, the size of which can be taken as the final one as to the number of elements, to the larger structures, the size of which can be taken as relatively endless, in conditions of impact of intentional and occasional software interferences on the assessed ITNs, as well as provision of adaptation capabilities of ITNs in conditions of impact of the destabilizing environmental factors.

It is possible to increase reliability of the result of comparative assessment of ITN structures by accounting of the prospective reduction of values of safety (protection) indexes of communication nodes and lines, as well as at the expense of the critical area occupied by the interval of values of the critical ratio of «dangerous» and «safe» communication nodes and lines obtained in experiments with various random sequences.

Provision of adaptation capabilities of ITNs in conditions of impact of destabilizing environmental factors is achieved by selection of the best (from the number of admissible alternatives) ITN structure, as well as by selection of the best solutions for restoration of the communication between the transit nodes. The assortment of alternative structures for the given purpose shall be preliminary found by monitoring of PUCN with the help of the specialized software like Visual Route or tracert (traceroute in Unix), ping and pathping tools built in Windows operating systems.

II. MEANINGFUL (PHYSICAL) PROBLEM DEFINITION

Routing of message batches in ITNs and transfer thereof via communication lines for provision of information exchange between correspondents is made in PUCN transit nodes.

Determination of the route of movement of message batches in PUCN is a complex task as between each pair of correspondents there is a large assortment of alternative routes. Selection of the route is made in PUCN nodes (routers of communication operators). Criteria of selection of the route from the number of admissible alternatives are prospective throughput capacity and workload of communication lines (channels); delays made by channels and their reliability; number of transit PUCN nodes and their reliability.

For provision of safety of information interaction of correspondents it is necessary to make comparative assessment of alternative ITN structures with due account of the capability to provide information interaction of correspondents in conditions of intentional and occasional software interferences resulting in reduction of the quality of ITNs and creating an abnormal load on the device's processes realizing the information interaction.

Such a task-setting enables to formulate the following contradictions.

Contradiction between the necessity to provide a high reliability of results of assessment and increase of the resource required for the resolution thereof caused by variation of the number of communication lines and nodes of ITNs exposed to the impact of interferences.

Contradiction between the need to give assessment to adaptation capabilities of ITNs and the necessity to obtain the given assessment of prospective values of safety indexes of communication nodes and lines accounting the destructive environmental impact.

The methods are aimed to elimination of the given contradictions.

Probability P^{vc} of violation of communication between correspondents (users) is taken as the integral index of ITN survivability, and the availability factor F^{A}_{i}, where $i = 1, 2, 3, \ldots, n$, characterizing the node's capabilities to provide users with communication services with the required quality - as the survivability index of the ITN node. The order of receipt of index values, particular criteria and their contribution to the final assessment are forth below in the text below.

The theoretical basis of the methods are the percolation theory, mathematical statistics theory and probability theory. Impact of intentional and occasional software interferences on ITNs causing sequences of failures is similar to the process of percolation specified in works [13, 14] and gives an opportunity to describe processes of the epidemic on the degrading ITN structure globally, but in a simple form. Within the framework of the percolation theory the given task is resolved on nodes and on connections [2].

III. ITN DEGRADATION MODEL, RESOLUTION OF THE PERCOLATION TASK ON NODES

In order to achieve the goal of the methods upon resolution of the percolation task on nodes the following sequence of actions shall be performed. It is necessary to set initial data: communication scheme of management bodies; requirements to the ITN quality indexes and the minimally admissible value of the complex safety index I^{Cmin}; identifiers of nodes and availability of communication lines between them. The structure and parameters of the distributed ITN (typology of its elements) are determined by the above-listed initial data. At that the communication scheme and requirements to the ITN quality indexes are set by the system of the higher level of the hierarchy – by the management system of the office, in which interests the communication is arranged. If it is impossible to receive the information on the PUCNs structure as the initial data from the communication operator, then it shall be preliminary found by monitoring of the PUCN with the help of the specialized software. Fullness and reliability of results of monitoring is determined by the quantity and mutual location (spatial span) of monitoring means. In the given case reliability is determined by the isomorphism of results of monitoring and of the structure of the real PUCN. It is expedient to have monitoring points in each PUCN-connected protected ITN segment. As a result such a multi-agent software will enable to settle tasks of the subsystem of monitoring of the topology and typology of ITNs for determination of the whole assortment of alternative ITN structures for information exchange between management bodies.

Availability (good action) factor of *i*-sequence ITN node is the availability factor calculated by the following formula: $F^{A}_{i} = ((T_i - T^{D}_{i}) / T_i) \cdot 100\%$, where T^{D}_{i} – duration of the time interval, within which services from the communication node with the required quality are unavailable to users («downtime»); T_i – aggregate time of work of the ITN node. Impact of occasional and intentional interferences on the ITN node creates an abnormal (additional) load on the communication and devices realizing it. As a consequence, T^{D}_{i} – duration of the time interval, within which services from the communication node with the required quality are unavailable to users («downtime») – increases, and the availability factor of the ITN note – decreases. Experience of ITN exploitation and experiments on its fragments show that the value of the minimally admissible value of the availability factor shall be set within the following interval: $0.6 < F^{Amin} < 1$.

Further it is necessary to calculate values of the complex safety index for each ITN node. The I^{C}_{i}, complex index of the *i*-sequence ITN node shall be understood as makeup (its rationed numeric value) of safety parameters characterizing the ITN node's capability to withstand realization of security threats. Calculation of I^{C}_{i} can be made by different methods: summation, multiplication or as the arithmetic mean of safety parameters of the unit. Besides, preliminary set initial data as ITN parameters shall include additionally set the minimally admissible value of the complex safety index I^{Cmin} for ITN nodes and alternative variants of connection of users to ITNs. The value of I^{Cmin} shall be set as a requirement (directive) with due account of realization of safety functions providing the level of the minimal confidence to the manufacturer and the operator of the equipment (regulated normatively).

Experience of exploitation of ITNs and experiments on its fragments show that the value I^{Cmin} shall be set within the following interval: $0.5 < I^{Cmin} < 1$.

Then it is necessary to compare the value of the calculated complex safety index I^{C}_{i} of the *i*-sequence ITN node with the preliminary set minimally admissible value I^{Cmin}.

When $I^{C}_{i} < I^{Cmin}$ the *i*-sequence node shall be memorized as the «dangerous» one, and when $I^{C}_{i} \geq I^{Cmin}$ the node shall be memorized as the «safe» one. Upon increase of communication nodes (till the relatively large quantity) in the ITN's structure there are, as a rule, alternatives of variants of routing of message batches. The required survivability and reliability of communication systems is achieved by backup of communication channels and by the known adaptive routing methods (realized locally by the equipment of communication operators).

Let's, for example, the *j*-sequence variant of the idealized regular ITN structure be a structure, in nodes of which there are communication nodes (Figures 1-2), the p_j-sequence share of which (black-color nodes) is the «dangerous» one, and the possibility of passage of message batches between users 1 and 2 is excluded. Chains (black-color nodes and connections between them) are formed from such adjacent nodes and are memorized. In the given example it is obvious that with the p_j-sequence part shown on (Figure 1, a) and (Figure 1, b) of «dangerous» nodes from their total number ($p_j = 0.3$) there is a large number of alternatives of routing of messages between ITN users (white-color nodes and connections between them on (Figure 1, b), some of them are shown on the figure by arrows).

For prospective reduction of I^{C}_{i} values caused by impact of occasional and intentional interferences on communication channels and ITN nodes it is necessary to increase the share of «dangerous» nodes by the value of Δp. The given value (Δp) shall be set within the interval of $\Delta p = 0.01..0.2$ of the required accuracy of calculation results. It follows from the figure (Figure 2, a) that with the p_j-sequence part of «dangerous» nodes shown on (Figure 2), where $p_j = 0.5$, there are only 4 alterative variants of routes of message batches between the users shown on the figure by arrows. In order to calculate p^{k}_{j}, the critical ratio of «safe» and «dangerous» nodes, for each *j*-sequence variant of connection of users it is necessary to increase the share of «dangerous» nodes consistently by the value of Δp

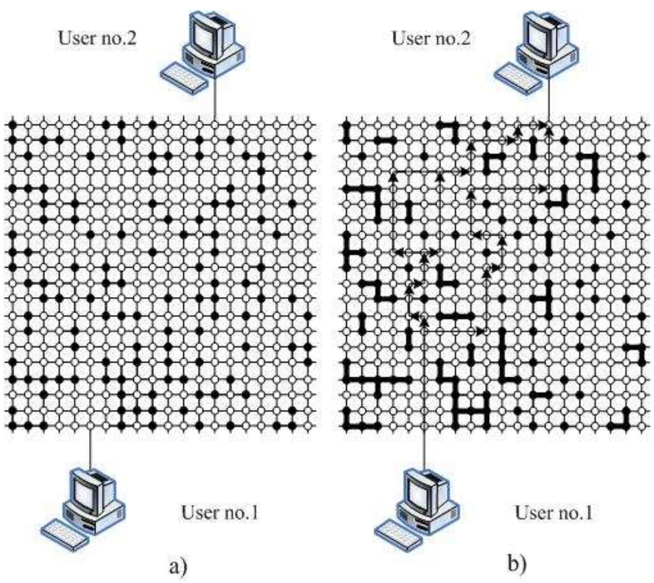

Fig. 1. Variant of the regular ITN structure with the different number of «dangerous» nodes.

(where, for example, $\Delta p = 0.01$) up to fulfillment of the condition $p_j = p^k_j$, at which the adjacent «dangerous» nodes create chains excluding an opportunity of information exchange for users.

After calculation of p^k_j, the critical ratio of «dangerous» and «safe» nodes, for each alternative ITN structure and ranking of alternative variants of connection of users to ITNs in accordance with p^k_j values it is necessary to select additional variants among them with the admissible p^k_j value (admissible variants) ($p^k_j \geq p^{ADD}$) and memorize them.

Then it is necessary to calculate the availability factor of each «dangerous» F^A_i of the *i*-sequence ITN node and to compare its value with the preliminary set minimally admissible F^{Amin}. Where $F^A_i \geq F^{Amin}$ it is necessary to memorize the *i*-sequence node as the «available» one, otherwise, i.e. where $F^A_i < F^{Amin}$ it is necessary to memorize the node as the «unavailable» one.

Then it is necessary to reduce the value of the availability factor of the ITN node F^A_i consistently by the value of Δd until fulfillment of the condition $F^A_i < F^{Amin}$. The value of Δd shall be set within the interval $\Delta d = 0{,}01 \div 0{,}1$ of the required accuracy of calculation results.

Further it is necessary to calculate duration of the time interval T^A_i, within which the condition $F^A_i \geq F^{Amin}$ has been fulfilled.

Interferences injected to one or more ITN points reduce availability of ITN nodes. Graphs on (Figure 3, b) and (Figure 3, c) illustrate the dynamics of alteration of the number of ITN nodes in the action front of the interference. For example, (see graph on Figure 3, b), in the «D» point the number of ITN nodes in the action front of the interference is equal to 35 nodes as of the moment of time $t_1 \approx 90$ sec: i.e. on the 90th second (from commencement of observation) interferences reducing the value of F^A_i by the value of Δd concurrently exist concurrently on 35 ITN nodes.

And for the time t^k_j the number of p_j «unavailable» ITN nodes will achieve the value of p^k_j (point «E_1» on (Figure 3, a) and point «E_2» on (Figure 3, c).

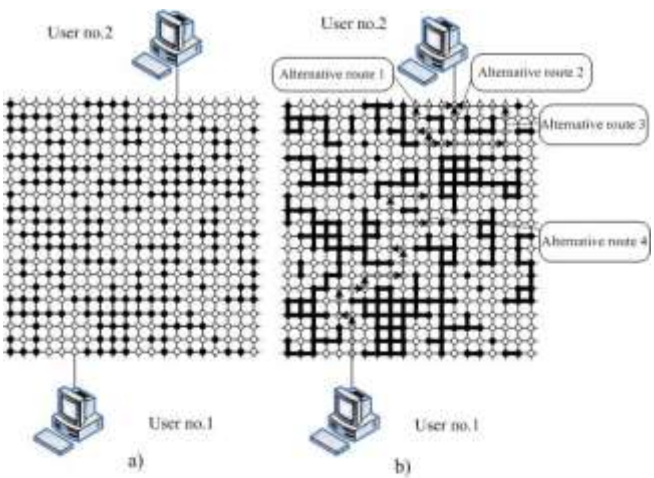

Fig. 2. Variant of the regular ITN, alternative routes.

Further, it is necessary to rank alternative variants of connection of users by the meaning of the p^k_j (critical ratio of «dangerous» and «safe» nodes) value. For the given purpose it is necessary to measure out t^k_j values of the alternative (competing) ITN structures on the time scale. Thus, for example, from graphs on (Figure 3, b) and (Figure 3, d): $t^k_1 \approx 260$ sec, $t^k_2 = 225$ sec.

From two competing (alternative) structures it is necessary to select the variants with the value $t^k_j \geq t^{k\,min}_j$ and to memorize them. Let's $t^{k\,min}_j = 250$ sec.

Then it is necessary to select from graphs on (Figure 3, b) and (Figure 3, d) the structure no.1 as $t^k_1 \approx 260$ sec that corresponds to the condition $t^k_j \geq t^{k\,min}_j$ (260 sec > 250 sec). If $t^{k\,min}_j < 225$ sec, then the reasons for selection are insufficient and an additional criterion is required.

A set of «unavailable» nodes connected with each other creates a cluster inside the ITN. For example, the task of search of the cluster's structurally separated branches connected with its frame via the sole node is formed.

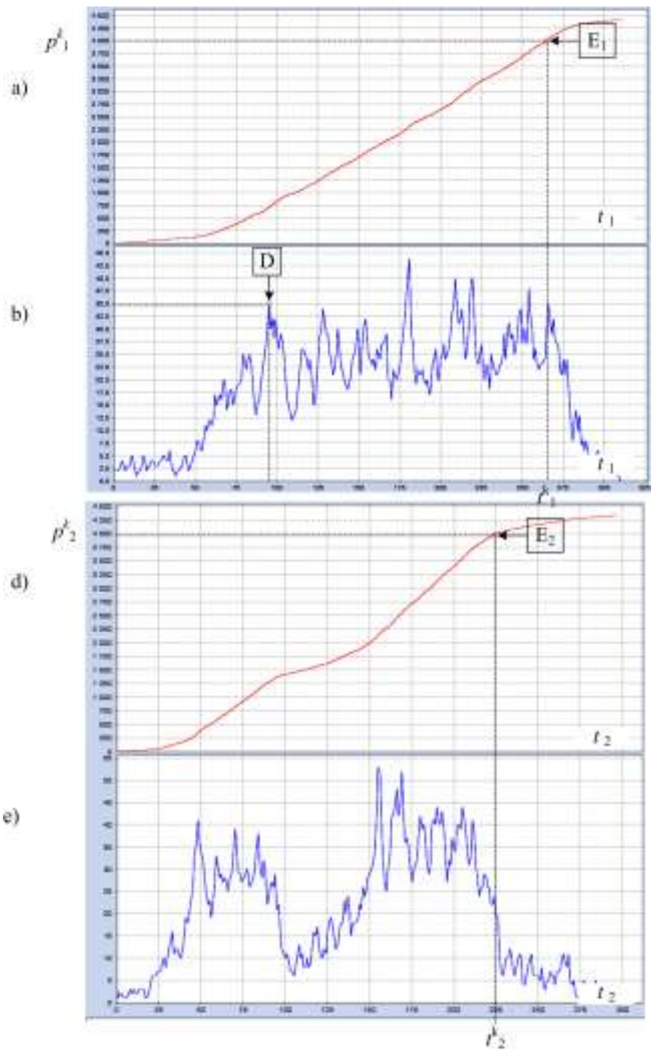

Fig. 3. Graphs illustrating the dynamics of growth of the number of «unavailable» ITN node in the two competing variants of the ITN structure.

It is expedient to construe the given task in the subject area of networks and communication systems as follows: it is necessary to find all «unavailable» ITN nodes, «replacement» of any of which by the «available» nodes will result in destruction of the cluster of «unavailable» nodes and restoration of the communication between users. Such nodes are called as the «dissecting» ones. The more «dissecting» nodes – the more prospective opportunities for restoration of communication between the ITN users.

On (Figure 4) in the ITNs general structure one of the «dissecting» nodes is highlighted.

For search of the «dissecting» nodes it is necessary [14] to calculate the connectivity index N of each i-sequence «unavailable» ITN node for each j-sequence connection of users, to set the minimal value of connectivity N^{min} of the «unavailable» transit ITN nodes, to select those «unavailable» ITN nodes, the connectivity index of which is $N = N^{min}$, and to memorize them. After that it is necessary to increase the F^{A}_{i} value of each i-sequence «unavailable» transit ITN node until fulfillment of the condition $F^{A}_{i} \geq F^{Amin}$ and to check availability of communication between users.

If communication between users is not restored, then it is necessary to increase the value of the minimal connectivity index N^{min} of «unavailable» transit ITN nodes by one. If communication between users is restored, then it is necessary to memorize the i-sequence «unavailable» transit ITN node as the «dissecting» one.

Further, for substantiation of selection of a structure from the number of alternatives it is necessary to rank alternative variants of ITN by the quantity of «dissecting» nodes and to select the variant with the maximum quantity of «dissecting» ITN nodes providing the largest prospective opportunities for restoration of the communication between users. Probability $P^{VC}{}_{j}$ of violation of communication between correspondents for the j-sequence structure is formalized as a functional dependence on the ratio p^{j} of «dangerous» and «safe» nodes. The share of «dangerous»

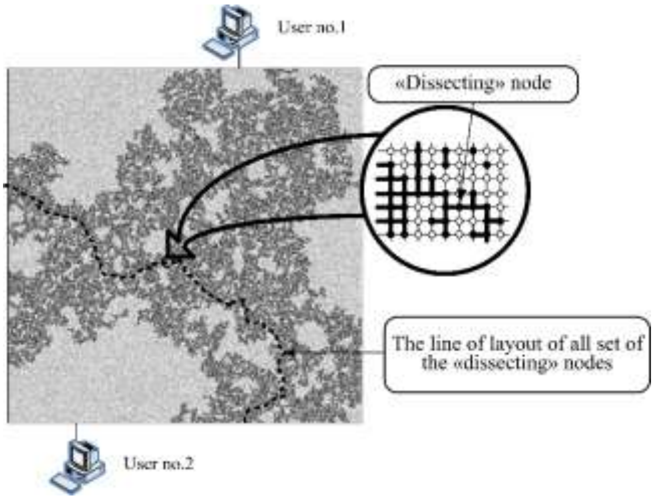

Fig. 4. Graphic interpretation of the «dissecting» node in the ITN, dimension 1000 x 1000 communication nodes.

where $p^{j} < p^{j}_{k}$, i.e. is relatively small one, provides admissibly small (and even negligibly small) probability of violation of communication between users.

Probability of violation of communication sharply increases upon increase of p^{j} up to the area of the critical values about $p^{j}_{k} \approx 0.6$, and when $p^{j} \rightarrow 1$ ($p^{j} > p^{j}_{k}$) increases up to the one [15].

IV. Comparative Assessment of the Final Structures of Integrated ITNs, Resolution of the Percolation Task on Connections

For the final structures the value of p^{k}_{j} – is a random value, the RMS deviation of values of which increases under the power-law with reduction of the number of communication nodes and/or lines. For the final structures there is no clearly defined threshold of p^{k}_{j}, but there is a critical area occupied by the interval of values $p_{j}^{k_D}$, obtained in *D-number* experiments with various random sequences. Besides, the critical value p^{k}_{j} for communication nodes in all practical ITN topologies is always less than the one for the communication lines as in case of failure of any one communication node not the one communication line, but all communication lines of the given node are disrupted. It means that assessment obtained without account of communication lines will be unreliable.

The percolation task on connections is resolved in the way similar to the task on nodes. It is necessary to set preliminary ITN parameters and alternative variants of connection of users. As parameters it is necessary to set identifiers of the network's nodes, communication lines between them; minimally admissible value of the complex safety index I^{Lmin} for communication lines; total number D^{max} of random tests providing reliability of results of experiments, the test's number shall be designated as $D = 1, 2, \ldots D^{max}$.

Imitation modeling of the ITN's degradation upon resolution of the percolation task on connections is performed in the way similar to the one specified in the above-mentioned task on nodes.

It is necessary to allocate memory arrays for storage of identifiers of users and alternative routes of message batches, two-dimensional memory array (Table I) for storage of values of the critical ratio of «dangerous» and «safe» communication lines $p_{j}^{k_D}$ of each of *D-number* random tests by each j-sequence variant of connection of users, where $j = 1, 2, \ldots$. It is necessary to form the topologic ITN scheme, from which it is necessary to allocate alternative routes of message batches for each pair of alternative variants of connection of users to the ITN. It is necessary to memorize alternative routes of message batches for each j-sequence variant of connection of users. The value of the current number of random tests D^{curr} shall be set as equal to zero.

In order to account prospective reduction of values of complex safety indexes of communication lines caused by impact of occasional and intentional interferences on the

ITN's communication lines it is necessary to increase the share of «dangerous» lines by the value of Δ*p* and to find $p_j^{k_D}$ – the critical ratio of «dangerous» and «safe» communication lines for each *j*-sequence variant of connection of users, at which the information exchange between users is excluded.

For the given purpose it is necessary to select at random the p_j^D-sequence part of communication lines from the total number thereof from each previously memorized variant of connection of users and to memorize them as the «dangerous» ones, to form connected chains from the adjacent «dangerous» communication lines and to memorize them, then it is necessary to increase gradually the share of «dangerous» communication lines by the value of Δ*p* and to repeat formation of the connected chain until fulfillment of the condition $p_j^D = p_j^{k_D}$ and to memorize the critical ratio of «dangerous» and «safe» communication lines $p_j^{k_D}$ in the two-dimensional memory array (Table I). The value of Δ*p* shall be set on the basis of the required accuracy of calculation of results within the interval of Δ*d* = 0.01 ÷ 0.1. The calculation result $p_j^{k_D}$ shall be registered in the table of the two-dimensional memory array for storage of values of the critical ratio of «dangerous» and «safe» communication lines (Table I).

TABLE I. TWO-DIMENSIONAL MEMORY ARRAY OF VALUES OF THE CRITICAL RATIO

j \ D	1	2	3	4	5	D^{max} =6	$\overline{p_j^{k_{D^{max}}}}$
1	0,726	0,548	0,262	0,738	0,250	0,417	0,490
2	0,565	0,318	0,271	0,129	0,341	0,071	0,282
⋮							

After that it is necessary to increase the value of the counter of the number of random tests D^{curr} by one and then to fix the number of the random test.

Each random test D^{curr} performed in the process of experiments with the help of the numeric modeling by the Monte-Carlo statistic test method results in formation of various structures from «dangerous» communication lines connected with each other and in receipt of random values $p_j^{k_D}$, which shall be memorized in (Table I), while the condition $D^{curr} < D^{max}$ limiting the total number of random tests is fulfilled. The small share of «dangerous» communication lines $p_j^D = p_j^{k_D}$ provides negligibly small probability of violation of communication between ITN users.

D^{max} total quantity of random tests providing reliability of results of experiments shall be calculated by the following formula: $D^{max} = Z_{\alpha/2}^2 / 4d^2$, where $Z_{\alpha/2}$ is standard normal statistics for the sought probability, *d* – acceptable error.

Alternative order of calculation of the quantity D^{max} of random tests upon practical realization of the imitation model D^{max} is as follows. For each variant of connection of users to the ITN *j* first it is necessary to calculate the regular value of the sequence $p_j^{k_D}$, where $D = D^{curr}$, and then to calculate the arithmetic mean $\overline{p_j^{k_D}}$ under the whole set of calculated values $p_j^{k_D}$, i.e. iteratively. The obtained sequence $\overline{p_j^{k_D}}$ tends to the exact resolution upon increase of the number of tests D^{curr}. Then the criterion of stoppage of the iteration process will be $\left|\overline{p_j^{k_{D^{TEK}}}} - \overline{p_j^{k_{D^{TEK}-1}}}\right| \le \varepsilon$, where ε is acceptable error. The value of the acceptable error shall be set declaratively, basing on the required accuracy of calculations. The range of values ε depends on the level of difference of the compared ITN structures and basing on the experience of calculations lies within the interval of $0{,}01 \le \varepsilon \le 0{,}1$. After completion of the iteration process D^{max} will be equal to D^{curr}.

Upon fulfillment of the condition $D^{curr} \ge D^{max}$ the value of the index of the center of the sampling distribution $\overline{p_j^{k_D}}$ under the whole set D^{max} of random tests for each *j*-sequence variant of connection of users shall be calculated as the mathematical expectation or the arithmetical mean or the geometrical mean or the harmonic mean or the average power value or the weighted average or the median or the mode values $p_j^{k_D}$ under the whole set of *D* random tests under each *j*-sequence variant of connection of users. Results of calculation of indexes of the center of the sampling distribution $\overline{p_j^{k_D}}$ under the whole set D^{max} of random tests for two alternative ITN structures and D^{max} = 6 are set forth in (Table I). At that in line 1 (Table I) there are results of calculations for the ITN regular structure with the connectivity of each communication node equal to four. In line 2 (Table I) there are memorized results of calculations for the ITN regular structure with the connectivity of each communication node equal to three.

The arithmetic mean value shall be calculated by the following formula:

$$\overline{p_j^{k_{D^{max}}}} = \frac{1}{D^{max}} \sum_{D=1}^{D^{max}} p_j^{k_D} . \quad (1)$$

For example, for line 1 (Table I):

$$\overline{p_1^{k_6}} = \frac{1}{6}\sum_{D=1}^{6} p_1^{k_D} =$$
$$= \frac{(0{,}726 + 0{,}548 + 0{,}262 + 0{,}738 + 0{,}250 + 0{,}417)}{6} = \quad (2)$$
$$= 0{,}490$$

The notions «alternative variants of connection of ITN users» and «alternative ITN structures» are synonyms equivalent from the point of view of application of the specified order of comparing of alternatives. If the ITN structure in the non-regular one, then upon different variants of connection of users thereto different structures will be created between such users as alternative ways of transfer of message batches.

After that it is necessary to rank alternative variants of connection of users to the INT by the meaning of the value of the index of the center of the sampling distribution and to select the variant with the maximum value of the center of the sampling distribution $\overline{p_j^{k_D}} \to \max$ among them. For examples of calculations specified in the table (see Table I) the variant specified in line 1 has the maximum value of the center of the sampling distribution.

After performance of comparative assessment under all above-mentioned indexes users shall be connected to the communication network and the information exchange between them shall be exercised [16].

V. Conclusion

Upon the ITNs work occasional and intentional interferences are inevitable and may result in failures in work of the ITN and, as a consequence, of the management system of the office.

Application of the methods enables to resolve the task of comparative assessment of survivability of ITNs providing increase of reliability of results of assessment upon variation of the number of communication nodes and lines in conditions of influence of intentional and occasional software interferences, to provide capabilities of the ITN structure to adapt to destabilizing environmental factors, as well to increase reliability of results of assessment of structures, the size of which may be taken and the final one as to the number of elements – communication nodes and lines, at the expense of accounting of the critical area occupied by the interval of values $p_j^{k_D}$ of communication lines obtained in experiments with different random sequences.

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