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Glushchenko V.M., Pronkin N.N. Methodology for assessing the integral potential damage to information security

Методология оценки интегрального потенциального ущерба информационной безопасности

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Abstract. *The article considers the methodology for assessing the integral potential damage to information security on the basis of system analysis.*
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The size of the integral potential and prevented damage to information security is determined by the destabilizing factors on the level of damage in the political, economic, environmental and information areas of the life of the metropolis.

Let $S^{п} = \{S^{п}_{l}, ..., S^{п}_{g}, ..., S^{п}_{G}\}$, $(g = \overline{1,G})$,

where:

$S^{п}$ – integral damage;

G is the number of destabilizing factors per damage level.

The categories of damages included in the lists of their significance are the primary semantic (semantic) information that reflects data on specific damages and the possibilities of a megapolis to prevent them.

The characteristic of the significance of potential and prevented damage is an ordered set of values of the linguistic variable "importance rank" = {first level (1), second level (2), third level (3), fourth level (4), fifth level (5)}.

Let's denote this set of levels by a = { a_1, ..., a_k, ..., a_K} $(K=\overline{1,5})$.

Let S = {S_1, ..., S_i, ..., S_I} be the set of estimated damages,

where:

i is the number of estimated damage;

I is the number of estimated damages.

At the same time, there is a need to solve the problem of determining the degree of importance (danger) of damages and, accordingly, the possible amount of integral damage to the information security of a megalopolis from their combined impact.

For information about a specific damage, the amount of damage and the degree of importance (danger) of damage are a function of time. We denote the function of the importance (danger) of damage to the i-th area of information security of a megalopolis in the socio-economic sphere, which is understood as the value of the relative potential (prevented) damage to information security of a megalopolis when it spreads for different time points, as a_i (T).

Any degree of importance (danger) of damage and the subsequent implementation of measures to ensure the prevented damage require costs to ensure them. On the other hand, premature disclosure of the significance of the damage information security metropolis in the socio-economic sphere S_i can lead to the manifestation of one or more information threats Y_i of the many possible:

Y={Y_1, ...,Y_u, ...,Y_U},

where:

$$u=\overline{1,U};$$

U – the number of possible data threats, implementation of which information security metropolis damage.

The magnitude of the relative damage to the information security of a megalopolis is determined by a certain rating – r_i.

When calculating the amount of relative damage, it is necessary to obtain estimates of several contradictory indicators:

- the amount of direct damage that can be caused to the information security of a megalopolis as a result of the implementation of potential information threats;
- the probability of causing this damage;
- the probability of carrying out measures that ensure the prevented damage by existing methods and means;
- the costs that are required for carrying out measures to ensure the prevented damage;
- losses resulting from the implementation of measures to ensure the prevented damage.

The magnitude of the possible damage and, accordingly, the required level of the potential of the measures taken to ensure the prevented damage depends on the scheme of their distribution.

We denote by $L = (L_1, ..., L_q, ..., L_Q)$ – the set of possible schemes for the distribution of events, and by L_i - the subset of schemes for the limited distribution of the i-th event.

These factors allow us to construct a certain criterion M, including the amount of possible damage to the information security of a megalopolis, guided by which it is possible to establish the rational degree of carrying out measures that ensure the prevented damage S_i at various points in the time of its use, i.e. to determine the rational function of measures $a_i^*(T)$.

In cases where the scheme of limited distribution of the i-th event L_i (T) is given, the solution $a_i^*(T)$ will be conditionally optimal. In the case when a rational scheme for the distribution of the i-th event $L_i^*(T)$ is chosen simultaneously with $a_i^*(T)$, we get the "best" solution of $a_i^*(T)$ for all possible schemes. Therefore, simultaneously with the definition of the function of measures $a_i^*(T)$ of information S_i by the amount of possible damage r_i (Y_i, L_i), a rational scheme $L_i^*(T)$ of its distribution is chosen, for which the implementation of measures should be ensured at the required level (maintaining the required level of prevented damage) and at the same time the benefit from its use is not lost.

In general, the task of establishing the rational degree of measures that ensure the prevented damage to the vital activity of the metropolis can be interpreted as follows.

Based on the available initial data (S_i, $S^П$, Y, L, T, a) according to the criterion M, which includes an assessment of possible damage to the information security of a megalopolis from the spread of information threats, it is necessary to find a rational function of measures a_i*(T) and at the same time a scheme for their distribution L_i*(T), if it is not fixed.

A direct search of all possible functions of measures and the search for a rational one is practically impossible due to the large number of assessments that must be carried out. Therefore, the problem under consideration is solved in stages:

- at the beginning (at time T_n) is determined by the possible damages $r_i(Y_i, L_i)$ and the importance of $a(T_n)$ events, providing prevented damage S_i;
- then, on many schemes of distribution of $L_i(T)$ is a rational scheme L_i*(T);
- for the sound scheme L_i*(T) or a fixed scheme, $L_{iq}(T)$ is determined by the function of the implementation of a_i* (T).

To solve this problem on a set of ratings $r_g(T_n)$ of avoided damages $S^П$ and included in the list (where T_n is the time of the emergence of information threats, and R is the scale of the damages or the value of the threat of information representing a fuzzy set R_k specified by a pair (R, $m_k(T_n)$):

$m_k(T_Н)$: R $\rightarrow$ a;

where

$m_k(T_n)$ – display of the grid on R are linearly ordered set of linguistic values of the variable "degree of importance" (the set a).

The value of the significance function a_i*(T) for time points $T_j \geq T_Н$ and the damage values comparable to it are determined by the maximum of the function of belonging of the rating $r_i(T_j)$ of the i-th damage to the corresponding subsets of the scale of importance (danger)

$$m_i(T_П \geq T_н) = \max_{\{a_k\}} m_{ki}(T_j)$$

Since the period of effective implementation of measures depends on the properties of its distribution schemes, at the same time as determining $a_i*(T)$ by the indicator of the effectiveness of the relevant measures S_i, a rational scheme of their possible distribution L_i *(T) is selected:

$$K_i(T_П \geq T_н) = \max_{\{L_q^i(T)\}} K_{qi}T_П \ ,$$

where:

$$K_{qi}T_П = \frac{C_{Yi}(T) - C_q^{ni}T_П}{1 - P_q^i T_П}$$

At the same time, the appropriate time T_j for reviewing the degree of importance of the prevented damage S_i is determined based on the analysis of the value of the "residual" damage to the information security of the megalopolis, taking into account the following restrictions:

$P_{qi}(T_п) \geq P_i{*}(T_п)$;

$C_{Yi}(T_п) \geq C_{qni}(T_п)$,

where:

- T_n – the initial time of making a decision to assess the degree of importance of the prevented damage S_i;
- $T_П$ – the time point for determining the main characteristics of the distribution schemes of measures that ensure prevented damage (forecast step);
- T_j-the appropriate time to review the degree of importance of the prevented damage S_i;
- K_{qi} (T_j) is an indicator of the effectiveness of an event that ensures prevented damage to S_i at the time T_j when it is distributed according to the q-th scheme;
- $C_{Yi}(T_j)$ – the cost value of possible damage from the implementation of the event S_i;
- C_{qni} (T_j) – the cost of losses from the limited spread of information threats S_i according to the q-th scheme at the time T_j;
- P_{qi} (T) – the probability of holding events S_i at the time T_j when it is distributed according to the q-th scheme;
- $P^*_i(T)$ – the required probability of holding events S_i.

To calculate the main components of the integral damage caused to the vital interests and information security of the metropolis due to the spread of information threats, special private methods are being developed to assess the direct damage caused to information security as a result of the spread of information threats. At the same time, the possibility of causing damage as a result of the implementation of threats is taken into account by evaluating the degree of manifestation of the corresponding threat by various appropriate methods, i.e. the degree of manifestation of the "threat – damage" relationship. There should also be special private methods for calculating and evaluating the prevented damage. The level (magnitude) of the integral prevented damage to the vital interests of the individual, society and the metropolis in the information field is the basis for making a strategic decision.

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