УДК 681.5.01

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TELECOMMUNICATIONS NETWORK OPTIMIZATION TAKING INTO ACCOUNT FACTORS AFFECTING ITS QUALITY INDICATORS

In the article the uncertainties and their impact on the network. Are considered emergencies as one of the factors of uncertainty. An Emergencies division on the effect on the telecommunications network and discussed ways to eliminate and avoid emergencies. Much attention is paid when an emergency does not lead to damage and destruction of the station.

Keywords: *uncertainty, emergency, telecommunications network, catastrophe theory.*

Introduction

At this stage of society telecommunications industry is a highly developed industries, which is a significant share of gross domestic income in the country. The main objective of the industry is the provision of telecommunications services of good quality. This task area must perform consistently despite any external conditions. That is, even in an emergency situation must act as proper permanent connection, so you can coordinate actions aimed at addressing the emergency. And that such a link existed should develop and optimize the information and communication network management system, which will be timely and adequately respond to external stimuli. The article is to determine the uncertainties affecting the operation of the network and their direct impact on the network and define the role of emergencies as one of the factors of uncertainty.

Main part

Production design optimization problem without random factors not clearly describe the processes occurring in the system.

In general, research and optimization of telecommunications networks makes it necessary to take into account two factors:

1. The presence of several criteria to evaluate the quality of the system;

2. The presence of noise, disturbances and other kinds of uncertainties, which are known only boundary changes.

For example, increasing the speed of information transfer (one criterion) can reduce the delay in the transfer of information (second criterion), but this should minimize the probability of error (the third criterion). At the same time in the operation of the network, the impact of noise on the signal (artificial, natural, white noise) and other disturbances, which are known only boundary changes.

Uncertainty can be caused by too early to unpredictable changes. The reason for their appearance can be errors in meter readings, the delay in the channels of information transmission. Uncertainties may also arise from exposure to network emergencies. Research of multicriteria tasks in similar circumstances creates new direction - a decision with many criteria and the availability of uncertain factors.

Thus, the uncertainty in the network may be due to the influence of external (eg, weather conditions, emergencies) and internal (eg, displays errors in measuring devices) factors. That is why during the optimization of network management systems need to perform multicriteria optimization network in the presence of uncertain factors. That is, to optimize the management system must determine not only the specific settings that are optimized but also specify the factors that are uncertain in the optimization, but are known boundary changes.

Moreover, with such optimization should be able to:

1. Determine the composition settings that are optimized - vector $x = (x_1,\ldots,x_m) \in X$ (X – specified the range of changes); specific value vector $x \in X$ defined as a «strategy of the first player».

2. Set the composition of uncertain factors $y = (y_1,\ldots,y_k)$, for which the region is known only changes Y; value $y \in Y$ defined as «the strategy of the other player».

3. Write down criteria $f_i(x,y), i \in N = \{1,\ldots,N\}$, which quantifies the effect achieved with a fixed $x \in X$ and a particular value $y \in Y$; a set of criteria $f(x,y) = (f_1(x,y),\ldots,f_n(x,y))$ called a vector function of winning, and specific values $f(x,y)$ – winnings.

Task management optimization is making the best network management solution, that task of the controlling problem boils down to a decision. Under objective decision criteria and in the presence of many uncertain factors will understand the system $\Gamma = (X,Y,\{f_i(x,y)\}_{i\in N}$, where the i-th criterion $f_i(x,y): X \times Y \to R^1$, and $X \in compR^m, Y \in compR^k$ – are closed and are restricted set of corresponding Euclidean spaces. Optimization is finding a specific value vector $x \in X$, where possibly achieved lower values of all components of the vector function win

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$f(x,y)=(f_1(x,y),\ldots,f_n(x,y))$, having in mind the possibility of implementing any value $y \in Y$. In this case it is the minimization function $f_i(x,y), i \in N$.

The presence of uncertain factors *y* lead to the fact that it is impossible to clearly define decision optimization problem.

This issue can be approached from two perspectives. First, it is useful to consider the decision in terms of the theory of of multicriteria task, given the multiplicity criteria. Secondly, it is appropriate to consider in terms of overall game theory, which determines the presence of the second player, that choice $y \in Y$ «prevents maximally» action first player. In this case there is an antagonistic game with vector- function winning.

The second approach examined in detail by scientists such as V.I. Zukowski, M.E. Salukvadze and highlighted them in the book [1].

The process of finding the optimal solution to the problems of designing control systems (as in multiobjective optimization, and taking into account the random factors) practically reduced to quantitative solution of nonlinear optimization.

As was noted earlier, telecommunication networks is an important factor in consideration of the uncertainties that may arise as a result of various factors, including emergencies and may have a different impact on the network, so it is appropriate to review the division and emergencies for their impact on the telecommunications network.

According to the Concept of development of telecommunications in Ukraine, which defines the basic principles and directions of further development of telecommunications networks in conditions of complex and changing environment, structure of management in case of emergency should be particularly flexible and adaptable. However, unlike the functions, tasks and ways of managing telecommunications networks in predictable situations, appropriate institutional mechanisms for the management of emergency situations should be adapted to identify new problems in the network and operational management decisions aimed at overcoming these immediate problems. As part of the management system should be possible to maximum concentration of resources of all telecommunications networks by combining their information, organizational and technical provisions for the speedy elimination of emergency situations.

Since any emergency situation occurs suddenly, suddenly, it poses telecommunications networks system management tasks that do not meet the stationary mode of operation under normal conditions.

As is known, today is an active transition from traditional networks to NGN (Next Generation Network), and in the period from 2015 to 2020 is planned to transition to the FN (Future Networks) [2]. NGN networks have tiered and FN also multidimensional structure. The latter, on the one hand, complicates the management structure, and on the other – increases the survivability of the network in an emergency.

The control system telecommunications networks should be able to operate in four modes:

1. Daily routine activity (stationary operation);
2. Daily high availability (active preparation and implementation of preventive measures);
3. Emergency Mode (action in an emergency);
4. Pislyanadzvychaynyy mode (long-term elimination of consequences of emergency situations).

The control system in stationary (everyday) conditions and in emergencies has different characteristics.

Emergencies can range from emergencies natural disasters to terrorist attacks. So the question is how will this or that emergency situation on the network.

Consider separately all kinds of emergencies is inappropriate - one and thesame situation may have a different impact on the network depending on its strength and other factors. More conveniently make a classification depending on the harm caused by an emergency network. Emergencies on the effect on the network have the following classification [3]:

1. Emergencies, in which the station was destroyed.
2. Emergencies, which resulted in some broken links and elements.
3. Emergency situations, in which there have been some uncertainty (noise, disturbance, etc.) with known boundaries change.
4. Emergency situations that do not lead to changes in the system.

Accordingly, in the first case when the station was completely destroyed, the main task is its quick recovery. The period of recovery stations in the network introduced temporary mobile station. In this case, the main task of the control algorithm is immediate sending a message about damage control center on the network. This message must have an advantage over other packets of information that have the highest priority.

In the second case where an emergency has led to the destruction of certain links and elements, the main objective is the rapid installation of damages and their elimination. To control algorithm main objective again is to establish the fact of damage and the immediate dispatch of notice damage to the network. And while there is repair of damaged algorithm blocks the transmission line to the damaged station and sends packets in other ways.

As for the third point, the specified situation can be predicted and avoided at the stage of optimization of management by taking into account uncertain factors. This case was considered in detail above.

If an emergency or any other effect on the network from the outside does not bring significant changes to the system, but only has a slight but permanent effect on the network, then sooner or later the system will take place hopping. That is, the system as a result of continuous accumulation of minor influence will collapse.

The disaster called stepwise changes that occur as a sudden response system in a gradual change in external conditions. Sources catastrophe theory is a theory Whitney features smooth maps and bifurcation theory of dynamical systems Poincare and Andronov. Enough detail researched theory of catastrophes VI Arnold and outlined in his book "Theory of disasters" [4].

In this case - with little permanent impact on network optimization main task management system is to determine the point of catastrophe and its distance.

To determine at what point will a disaster, you need to find features (crease, assembly, «dovetail», «pyramid», «wallet», etc.), and for this you need to analyze a mathematical model of the object.

The mathematical model can have one or more minimum (depending on the control parameters). If you change the control parameters minimum position changes smoothly, the jump does not occur, according catastrophe will be. The disaster would be the case when the local minimum disappear, merging with a local maximum. If the analysis of the objective function found extremes, and set certain features (crease, assembly, «dovetail», «pyramid», «wallet», etc.), it can be argued that such points arise disaster. Thus, examining the objective function, we can determine the point at which there will be a disaster and avoid it. In any system for characteristic features can determine that it contains a catastrophe. These features are called flags disasters. Key features of disaster:

1. Modality - a property of the object system, which is that for some values of control parameters may be multiple equilibria systems (several events).

2. Unattainability - one of the system equilibrium is reached and observed.

3. Catastrophic jumps - abrupt transition of the system from one equilibrium to another.

4. Hysteresis - transition system from one state to another and vice versa at different values of control parameters.

5. The difference - a small shift in the way the parameter space leads to qualitatively different end of the system.

Usually these symptoms occur together. They depend on the physical distance control system variable region of space in which capacity has more than one local minimum. When detected at least one of these signs, you should state that will collapse and control parameters advisable to change so that you can discover the rest of the signs, which must manifest itself under certain conditions. There are other signs of the disaster – the difference linear response, critical slowing (mitigating fashion) and anomalous dispersion. They observed even when the potential has only one local minimum. This can be used for installation as critical values and safe limits of control parameters in many cases where unexpected "catastrophic jumps" can be detrimental to the system.

Conclusion

Uncertainties in telecommunications networks - is one factor that is unchanged. Taking into account the uncertainties miscalculation of possible manifestations and prevention effects are the basis of qualitative functioning telecommunications network. And one of the factors is the emergence of uncertainties emergencies. Division of emergency situations criteria for impact on network allowed to describe actions on liquidation of consequences and predictions for each variant deployment event.

List of literature

1. Жуковский В.И. Многокритериальные задачи управления в условиях неопределённости / В.И. Жуковский, М.Е. Салуквадзе. – Тбилиси: Мецниереба, 1991. – 128 с.

2. Хиленко В.В. Сетевой интеллект и сети нового поколения NGN: тактика и стратегия операторов / В.В. Хиленко, В.Ф. Михайлов // Зв'язок. – 2002. – №2. – С. 6–10.

3. Жебка В.В. Оптимізація інфокомунікаційної мережі в умовах надзвичайних ситуацій / В.В. Жебка // Системи управління, навігації та зв'язку. – Полтава: ПНТУ, 2013. – № 4 (28). – С. 134-137.

4. Арнольд В.И. Теория катастроф / В.И. Арнольд. – М.: Наука, 1990. – 128с.

Надійшла до редколегії 9.04.2015

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ОПТИМІЗАЦІЯ ТЕЛЕКОМУНІКАЦІЙНОЇ МЕРЕЖІ З УРАХУВАННЯМ ФАКТОРІВ ВПЛИВУ НА ЇЇ ЯКІСНІ ПОКАЗНИКИ

В.В. Жебка

В статті розглянуто невизначеності та їх вплив на мережі. Розглянуто надзвичайні ситуації, як один із факторів невизначеностей. Наведено поділ надзвичайних ситуацій за впливом на мережу телекомунікацій та розглянуті шляхи ліквідації та уникнення наслідків надзвичайних ситуацій. Велику увагу приділено тому випадку, коли надзвичайна ситуація не призводить до пошкодження та руйнації станції.

Ключові слова: *невизначеності, надзвичайна ситуація, телекомунікаційна мережа, теорія катастроф.*

ОПТИМИЗАЦИЯ ТЕЛЕКОММУНИКАЦИОННОЙ СЕТИ С УЧЕТОМ ФАКТОРОВ ВЛИЯНИЯ НА ЕЕ КАЧЕСТВЕННЫЕ ПОКАЗАТЕЛИ

В.В. Жебка

В статье рассмотрены неопределенности и их влияние на сети. Рассмотрены чрезвычайные ситуации, как один из факторов неопределенности. Приведены разделение чрезвычайных ситуаций по влиянию на сеть телекоммуникаций и рассмотрены пути ликвидации и предотвращения последствий чрезвычайных ситуаций. Большое внимание уделено том случае, когда чрезвычайная ситуация не приводит к повреждению и разрушению станции.

Ключевые слова: *неопределенности, чрезвычайная ситуация, телекоммуникационная сеть, теория катастроф.*