SECTION 17.
COMPUTER AND SOFTWARE ENGINEERING

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FEATURES OF DYNAMIC ROUTING IN VPN-CHAIN UNDER INCOMPLETE DATA CONDITIONS

Over the past several years widely applied practice of using chained constructed https://wooordhunt.ru/word/recurrent circuit of virtual building computer networks [1]. Such networks are characterized by a high level of delay in data transmission due to multiple transformations of network packets, but at the same time the level of security of data transmitted through such networks is increasing. The main driver for the development of such concept is the gradual transition to web-based technologies of computerized systems, information subjects and industrial systems in the context of rapid expansion of the fourth industrial revolution [2].

An urgent task is the development of the theory of dynamic routing in such virtual networks. In this connection, there is a concept of incomplete data, i.e. the inability to predict all incoming events that affect the functionality of virtual private networks (VPN). For a VPN chain with a permanent topology and voltage on the communication channels, can be written the routing task in general way, taking into account the decrease in the efficiency of communication channels with increasing voltage. Thus, for directed graphs, $G = \langle V, E \rangle$, $V = \{\upsilon_i\}$, $E = \{e_j\}$, with a capacity of the arcs $c(e) \forall e \in E$ and the matrix of requirements *D*, which for each pair $(s,t) \in V \times V$ specifies the value of the flow *D (s, t)* from the vertex s, which is called the source to the vertex *t*, which is called the sink. Each pair *(s, t)* and the arc *e* can be compared with a variable $f_e^{(s,t)} \geq 0$, denoting the volume of traffic from *s* to *t* along the arc *e*, and then the total flow through the edge *e* will be defined as:

$$l(e) = \sum_{s,t \in V} f_e^{(s,t)} \tag{1}$$

Considering the piecewise linear approach to determining the values of the cost function of using the edges *e* and set conditions of cost increase, the equation of the flow balance (1) can be rewritten as [5]:

$$\sum_{u:(u,v)\in E} f_{(u,v)}^{(s,t)} - \sum_{u:(v,u)\in E} f_{(v,u)}^{(s,t)} = \begin{cases} -D(s,t), \ якщо \ v = s, \\ D(s,t), \ якщо \ v = t, \quad v,s,t \in V \\ 0, \ в \ інших \ випадках. \end{cases} \tag{2}$$

In the above formulation, the problem is solved by the SPF algorithm [3], and the main attention is focused on the choice of values ξ_n^1 and ξ_n^2 the justification for the choice. A routing that satisfies the conditions of the problem is a function of time, therefore, its calculation (except in trivial cases) can be performed only using a distributed procedure that performed on the nodes that it includes. This is due to the fact that the prediction of the behavior of *G (t)* and *D (t)* cannot be obtained. To calculate another section of the route, you need to know exactly the state of the virtual network in some surrounding area of the node that optimizes traffic within this area. Approximate knowledge of the external area (outside the selected area) is enough to select an intermediary node for further route planning of the VPN-chain. Differentiated representation of information about the structure of the network near the node that builds the route, and information about remote areas of the network, allows you to make a quality choice of the intermediary node. The information and structure of the network near this node must be the most accurate and complete, and its remote areas can be approximated.

There are three options for collecting route information and way of building a route. The first option corresponds to algorithms based on the distance vector, which is represented by the RIP protocol. Information gathering is carried out only with the help of the nearest neighbors, assuming that they have reliable information. The transmitting of user information is similar: only the nearest neighbor is defined, which can transmit data on the optimal route. This method of routing is simple to implement, requires virtually no computational burden, but tends to form loops.The second option corresponds to algorithms based on SPF [3]. There the information is gathered from all network nodes, each router (in some cases, for this purpose is used multicast messaging). The construction of the route is performed by each node independently only on the basis of the information it has, but it is assumed that all routers possess the same topological bases, matrices of requirements and channel loads.

Thus, by limiting the "scope of competence" of each node, can be increased the accuracy of information about the nearest sections of the virtual network, intentionally reducing the accuracy of the representation of remote sections. The routing algorithm in virtual networks, where virtual elements of the IaaS-infrastructure are used as nodes, and the process itself takes place in an automated way, can be conditionally called as routing algorithm using incomplete data. All its features are listed in this paper.

References:

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