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CONDITIONS OF IMPROVEMENT PERFORMANCE AND SCALABILITY IN FAULT-TOLERANT IP ROUTING

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Practically fault-tolerant routing based on reservation of network resources usually associated with decrease in overall performance and scalability of protocol solutions. In accordance with the need of implementation the requirements to promising solutions in ensuring fault-tolerant routing, it had been further developed the flow-based model of fault-tolerant routing in telecommunication network, aimed to realization of main reservation schemes of network elements and their throughput [1, 2].

Represented solution based on approach used in [2, 3], and it is realized as nonlinear flow-based model in which the conditions for link overload prevention are modified for the case when only some flows can switch to backup routes but not all of them. With the purpose of preventing the primary and backup paths overlapping with realization of different backup-schemes it was added several additional restricting conditions that connect routing variables to calculate the primary and backup path trees [4].

Using the model [4] considered two variants of its application, which characterized the ability of overload prevention of network links by flows through primary and backup paths. These conditions help to prevent the links overload in telecommunication network (TCN), even when only some flows can switch to backup routes but not all of them. In this case for these flows will always be some unused throughput of communication links reserved paths, thereby realizing protection scheme of the throughput in organization fault-tolerant routing in TCN.

Due to the fact that in general the choice of routes (both primary and backup) in telecommunication network can be done in many ways, it is advisable to formulate fault-tolerant routing as optimization problem. An important consideration in the formulation of any optimization problem is the choice of optimality criterion of solutions obtained. The form of criterion must adequately reflect the physical sense of the process being modeled, and on the other hand provide the possibility of obtaining the desired results with the specified requirements (acceptable accuracy, computational complexity in real-time, etc).

Need of calculation both the primary and backup paths associated with an increase in processing load of network routers, and the need to support the routing tables of increased dimension to store the data about primary and backup paths. Moreover, it is necessary not only to calculate these two types of routes, but also maintain in the active state. In general, these factors, together with a reduction in the performance of TCN, negatively impact on the scalability of solutions associated with the fault-tolerant routing. This is especially critical for large dimension TCNs and branched network structure (high connectivity nodes). This results in the calculation of routes (primary and backup) with a large number of communication links and routers.

These disadvantages are common to all technologies related to improving network reliability as a whole, and are a kind of "cost" for the maintenance of a specified level of fault-tolerance of final solutions. To minimize these drawbacks it is desirable that the result of calculations the backup path must be less different by links and nodes from the primary. This should help to ensure that the reservation will use minimum of network throughput that have a positive impact on its performance and the quality of service performance in general. Furthermore, in this case in network nodes for each flow there is no need to be stored two routing tables (for primary and backup path). Only one routing table will be needed, but with minimum necessary adjustments concerning differences primary and backup paths.

In the proposed model provided a fault-tolerant routing problem solution by minimization additive metric of primary and backup paths [3, 4]. Moreover, fulfillment of model`s condition guarantees that the primary path will be always more effective in rate, packet delay, i.e. «shorter» than the backup one within the chosen routing metrics. As the metrics can be performed functions of the key functional characteristics of communication links: throughput, delay, packet loss, etc.

The novelty of the proposed model is the modification of objective function to be minimized by the introduction of the quadratic term, responsible for ensuring that the primary and backup paths differed only by network elements need to be protected (ideally only by problematic network element). This contributed to the fact that just minimum of network links throughput will be reserved, so that will have a positive impact on its performance and the quality of service parameters in general.

Research of the proposed model confirmed its efficiency in terms of obtaining the desired solutions in real time [4]. Numerical examples demonstrated the advantages of the proposed improvements in relation to overload prevention in communication links, and improvement of scalability and performance of the solutions obtained in whole.

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