

A Flow-Based Model of Two-Level Routing in Multiservice Network

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Abstract – In this paper an approach to the flow-based modeling of two-level routing in multiservice networks is considered. The model supports the source routing. At the low level – the level of edge routers – the routes are directly computed, and at the top level the received decisions are coordinated for excluding overloads of communication channels in a multiservice network.

Keywords – Multiservice Network, Quality of Service, Two-Level Routing, Mathematical Model.

I. INTRODUCTION

Modern telecommunication Next Generation Networks (NGN) should be built as multiservice networks with support of Quality of Service (QoS) standard. The important role at the maintenance of QoS plays routing protocols. Thereupon the further development of flow-based model of routing with its adaptation in imitation of multilevel computing procedure for the purpose to increase the scalability of received decisions is offered.

II. FLOW-BASED MODEL OF TWO-LEVEL ROUTING

Let the nodes of an m -node network be represented by the integers $1, 2, \dots, m$, and let a link from node i to node j be represented by (i, j) . Let $E = \{(i, j) : \text{a link goes from } i \text{ to } j\}$ be the set of links. For each link $(i, j) \in E$ its transmission capacity ϕ_{ij} is typical, and with each traffic from the set K the subset is being confronted: r^k , s_k and d_k – intensity of k -traffic, source node and recipient node respectively. Quantity x_{ij}^k is control variable, which characterizes the intensity of k -traffic, running in the link $(i, j) \in E$.

For the purpose of prevention of network nodes overload it is necessary to meet the condition of flux conservation:

$$\begin{cases} \sum_{j:(i,j) \in E} x_{ij}^k - \sum_{j:(j,i) \in E} x_{ji}^k = 0; & k \in K, i \neq s_k, d_k; \\ \sum_{j:(i,j) \in E} x_{ij}^k - \sum_{j:(j,i) \in E} x_{ji}^k = r^k; & k \in K, i = s_k; \\ \sum_{j:(i,j) \in E} x_{ij}^k - \sum_{j:(j,i) \in E} x_{ji}^k = -r^k; & k \in K, i = d_k. \end{cases} \quad (2)$$

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Condition of the links congestion avoidance:

$$\sum_{k \in K} x_{ij}^k \leq \phi_{ij}; (i, j) \in E, \quad (3)$$

and also conditions of realization of multipath routing strategy: $0 \leq x_{ij}^k \leq r^k$. Besides the model is added by guaranteeing conditions of quality of service assurance on several figures [1] that is very important for multiservice networks.

On each frontier node (low level of calculations) the calculation of variables x_{ij}^k for the traffics coming to this node is supposed by minimization of the following cost function:

$$T = \sum_{k \in K} \sum_{(i,j) \in E} c_{ij}^k x_{ij}^k, \quad (4)$$

where c_{ij}^k – weighting coefficients.

However at the source routing transmission capacities of communication channels can be used by traffics of various frontier nodes discordantly. Thereupon at the top level the received decisions are coordinated according to the methods of decomposition coordination [2] for the purpose to exclude links congestion by traffics, which are routing from various frontier nodes. In the general case the decision process has iterative character, and the quantity of iterations depends first of all on the character of requirements to quality of service of users traffics.

III. CONCLUSION

In the paper the mathematical flow-based model of two-level routing in multiservice network is offered. In the course of model using the conditions of overload preventing for the basic network elements are considered: nodes and communication channels, conditions of realization of multipath routing and support of QoS. This model is based on two-level procedure of routing tables calculation for the purpose to increase the scalability of decisions.

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