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Cost minimization when a message is transported in the big network

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Definition of cell-net is "a connection of closed rings". Based on rings attributes one method of transport cost calculation is when information transport is offered. Two prepositions in choice of the best path are decided.

In large telecommunication networks, finding the optimal route is usually associated with several difficulties, dictated by the sole definition of the word "large". Connection between pair of nodes via node chain can be done in multiple variants. Optimization requires selection of criteria universal enough to be used, usage of known algorithms, and reducing task complexity if possible. This set of requirements is contradictive. Proposed routing algorithm suggests elimination of existing difficulties with reasonable division of the network node and link sets to several subsets with significantly reduced routing problem complexity. This creates an opportunity to use results obtained in previous steps for each current routing step.

Methodic reflects some peculiar properties related to cell nets. Here are some definitions. Elementary Ring (ER) is a set of n nodes, linked with n links, which can be interpreted as a closed subset of some network node set. Cell-Net (CN) is the telecommunication network consisting of Elementary Rings. With definition of Cell-Net rings are connected together with common links and/or common nodes. Connection using common links is in fact a link of two different Elementary Rings. In the routing process, several steps of different levels are considered: selection of optimal route on ER level, and continuation of routing on CN level. For solving the first step, incidence matrix of nodes is being calculated and used in process of selection the route between start and end nodes. In the ring, the beginning and the end of the route can be linked together on the Ring level. As a criteria of route being optimal, relative costs are being used: the relation of sum of costs of transitions between ERs on one route, to a sum of transition costs of all routes. Costs of each transition is being calculated by several relative parameters: expense of transiting the link owned by two coincident ERs related to the sum of all such expenses for all links of the route. Number of routes on the Ring level is much smaller, than number of routes on node level, thus optimal route on ring level can be found just by simple comparison using selected criteria. This, however, does not guarantee that found route on Node will be contained on found route on the Ring level, but the probability of such event is high. Second step of problem optimization is finding an optimal route as chain of Nodes as a part of route found on the Ring level. This is a known task, and can be solved by any existing method. By using dynamic programming approach, with known start and end nodes, fixing the best solution on each step provides a way to quickly reconstruct the whole route. Advantage side of dynamic programming approach is using results of previous steps on the next step, and it effectively aligns with proposed algorithm. Knowing obtained route, it is needed to check if it is a part of any different routes on the Ring level. If yes, the process needs to be repeated on the ring level, and if no, then another route on the ring level must be chosen to continue the procedure. In any case, analysis of each route on the ring level always uses at least one of previously found solutions.

Program complex presented provides blocks fully corresponding to proposed method, in particular input data with costs for every link, incidence matric computation for each ring on ring level, computation of optimal route on ring level, selection of the best route based on relative costs. Program complex is successfully tested on several examples with satisfactory results.