Optimization of invariant telecommunication network using simulation modeling

Galina Gayvoronska

Abstract - **This paper presents theoretical approach, algorithm and software solution for building optimal evolution plat of telecommunication network.**

Keywords - ***Network evolution, equipment positioning, optimization for minimal cost, knapsack problem, transportation problem.***

I. INTRODUCTION

One of the most significant factors, affecting evolution process of modern telecommunication networks, is fast changing technologies of transmission and distribution of information. Often new technologies have significant influence on structure of evolving network. At this time not only quantitative parameters are rising, but significant qualitative changes appear, which in the most cases require rethinking of the basic principles of network construction.

This leads to necessity of method for creation optimal scenario of network development in space and time. Before this, there were only calculations of network nodes interaction in a fixed point of time and analysis of specific node evolution in time, abstracting away of its connections. This paper propose solution of optimization network evolution, taking to account both space and time aspects.

II. INSTRUCTION FOR AUTHORS

Purpose of this work is to develop algorithm for simulating telecommunication network evolution, taking to account expenses on modernization of the network, which means installing new commutation systems and introduction of remote modules. Expenses on serving existing and new equipment should also be taken to account. Algorithm should result in optimal network structure according to minimum cost criteria.

Hardware and software are considered as constraints, which should be satisfied during network evolution. Constraints, used for algorithm development corresponds to nomenclatural documents of communications administration of Ukraine. Network being examined is discussed in [1], economical analysis of network evolving when new equipment is being introduced — in [2, 3].

Beforehand evolution cost C^A for strategy of continuous growth is calculated, which will be used later as a etalon for defining economical suitability of other strategies. Positioning problem for base and remote equipment, when cost of evolution should be minimal and equipment availability constraints should be satisfied is solved as transportation problem. Optimization procedure results in three sets $X=\{x_{it}^*\}$ $Y=\{y_i^*\}$ and $Z=\{z_{it}^*\}$, corresponding to minimal value of target function, according to which nodes set is divided to mutual exclusive three classes: $I_A=\{i\in I \mid y_i^*=1\}$- nodes, where equipment is not changed; $I_R=\left\{i\in I \middle| \sum_{t\in T} x_{it}^*=1\right\}$ - nodes, where new remote modules are installed and $I_D=\left\{i\in I \middle| \sum_{t\in T} z_{it}^*=1\right\}$ - nodes, where new base equipment is installed.

Then for each potential base node, using chosen places for base and remote modules, remote modules are being positioned as a solution of modified discrete knapsack problem; Target function is defined as a sum of discrete values under additional constraints. This problem satisfies optimal for subtasks condition, but unlike its continuous analogue, it cannot be solved with greedy algorithm.

Practical application of the procedure showed good results for different source data. To implement procedure as a software solution, program specification was written and instruments were chosen. Three software products were built: for setting parameters of space-time system, solving optimization problem and presenting reports for optimal solution. Module architecture of software complex allows easy expansion of its features for solving different problems of network evolution analysis.

III. CONCLUSION

Solution of the optimization problem for evolution of invariant telecommunication network is proposed. Allowed set of remote modules are defined via solving knapsack problem, what allows to develop universal algorithm of maximization of target function of cumulative remote modules capacity per one base node. Conditions of this maximum are also found. Algorithmic procedure for adding extra base nodes, if current base nodes cannot serve all needed remote modules is developed. This guarantees, that all requirements for connection to the network will be satisfied, keeping network cost minimal.

REFERENCES

[1] Гайворонская Г.С. Проблема синтеза развивающихся информационных сетей, сборник ДУИКТ №3, 2005, Киев с.14-21

[2] Гайворонская Г.С. Экономические аспекты модернизации телекоммуникационной сети// Зв'язок. – 2007. – №2. – С. 15-20.

[3] Гайворонская Г.С. Экономические аспекты оптимизации эволюционной политики развития местных сетей связи. Сборник международной академии информатизации при ООН, Acta Academia, 2001, Chisinau: Evrica, 2001, с. 93- 98.