ANALYSIS OF CHORDAL RINGS

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Abstract – In this paper the problems of searching of a parameter deciding about the transmission abilities of the chordal ring and definition of the reference graphs has been presented.

Keywords – Graph theory, chordal ring, node degree, diameter of graph.

I. INTRODUCTION

The contemporary telecommunications systems are usually designed and constructed as a large distributed network structures. This type of telecommunication systems consists of a certain number of intelligent switching modules that communicate among themselves by an interconnection network. In order to ensure communication ability among these modules the special networks built of equal links of high transmission capacity are used. One of the most important problems in design and analysis of distributed systems is the way in which the system components are connected together, since the topology of interconnection determines the performance of the whole system.

The analysis of telecommunication systems has made it possible to conclude that the price of setting up one link depends more on the environment in which such link is placed (a set number of VC12 virtual containers used to carry information between two nodes of SDH ring or the length of the light wave in WDM system) than on its length. The above conclusion allows us to assume that the costs of all links of the designed structure are equal. This assumption is true only for certain number of transmissions links because the considerable increase of the number of links needs modification of the installed transmission equipments, which incurs additional costs. The assumption is that the traffic value among the modules creating the structures is similar. Apart from minimising the implementation costs, the network has to have certain quality parameters set for information transfer among the modules of distributed system. The quality parameters of information transfer are e.g. time delay or probability of rejection of call being transmitted from one module to another.

The graph theory is very useful to analyse the networks connected modules in a distributed system. For a given communication structure, the value of quality parameters of information transfer depends on transmission parameters of a graph describing the network e.g. graph diameter.

II. FORMULATION OF THE PROBLEMS

A problem of choice of a communication network of distribution systems is as follows:

For a given number of modules in distributed systems we should find such symmetric topology, which minimizes the total number of links of this structure, and ensures the level of quality parameters destined for information transfer in the network.

Among the analyzed structures (hypercubes, meshes, Cayley's graphs, etc.) the chordal rings are useful as communication networks connecting distributed modules. They have quite good transmission abilities and good extesibility.

Arden and Lee [1] proposed using of chordal rings as the networks in multicomputers. The basis for forming chordal graphs is the ring structure (described by Hamilton cycle). The nodes represent the system modules, the edges - links connecting these modules. Ring structure is the one of cheapest networks but it has the worst transmission properties. In order to improve the transmission properties Arden and Lee proposed to introduce the additional edges, called chords, which link nodes. They obtained a regular graph of 3rd degree. In their work they have shown that the transmission abilities of chordal rings depend on the chord length. They assumed that the basic graph parametre which decides about transmission abilities of chordal rings is the graph diameter. However, having performed simulation of the chordal rings we could observe that the diameter does not always decide of its transmission abilities.

For evaluation of transmission properties of analysing structures the determination of reference graphs became essential because the parameters of these graphs consitute a reference model for the analysed structures.

In their work L. Narayanan and J. Opatrny [2] have introduced a term „optimal chordal ring 4th degree". The number w of nodes in this ring is given by the formula $w = 2\,d(G)^2 + 2\,d(G) + 1$, where $d(G)$ means the graph diameter. They have proved using the geometrical method [3], that the chord length s of such graph is equal to $s = 2\,d(G) + 1$. As the optimal graphs 4th degree can only be defined for a determined number of nodes, the definition of reference graphs for any number of nodes in a ring became very important.

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