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Topological Design of Computer Communication Networks

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ABSTRACT: The goal of topological design of a k-connected computer communication network is to achieve a specified performance at minimal cost/delay. Unfortunately, the problem is completely intractable. A reasonable approach is to generate a potential network topology. Stieglitz, Weiner and Kleitman have presented a heuristic for generating a potential network topology. This heuristic begins by numbering the nodes at random. This paper presents a systematic method for numbering the nodes when the nodes (assumed even in number), all lie on a straight line, are equispaced and the connectivity that is sought is even. Assuming that the cost of a link is proportional to its length, the method presented has been found to give the cheapest starting network. When the nodes are numbered in a systematic manner, the potential network topology requires minimum perturbation before an acceptable network is found.

KEYWORDS: Topological Design; Computer Networks; Straight line topology-Link deficit Algorithm.

I. INTRODUCTION

The fastest available computers cannot optimize a 25 node network, let alone a 100 node network [2]. A potential network topology can be generated using the link deficit algorithm [1, 2].This heuristic begins by numbering the nodes at random. In general, different starting networks result when the numbering of the nodes is changed [3]. The cost of a link is assumed to be proportional to its length. We now present an algorithm to number the nodes of a computer communication network when all the nodes (assumed even in number) lie on a straight line, are equispaced and the connectivity that is sought is even.

II. ALGORITHM FOR NUMBERING THE NODES

The N nodes (N even) which lie on a straight line and are equispaced are shown in Fig1.

. . . . . .

Fig 1

Starting from left, the nodes are successively numbered 1, 3, 5,..., (N- 1).The remaining nodes on the right are successively numbered N, (N-2), (N-4), …,2.

III. ILLUSTRATIVE EXAMPLE

Six nodes lie on a straight line and are equispaced. We desire to set up a 4- connected network. Using our algorithm, the nodes are labeled as shown in Fig 2.[10]

. . . . . .

1 3 5 6 4 2

Fig 2

Application of the link deficit algorithm gives the starting network as shown in Fig 3.

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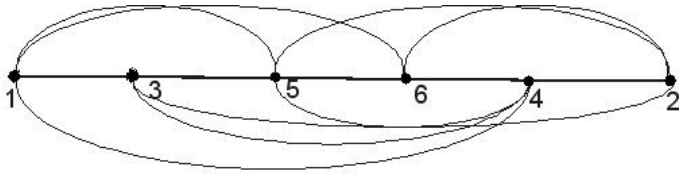

Fig 3

It is easy to see that any other labelling of the nodes gives rise to a starting network with higher cost.[7,8]

IV. SIGNIFICANCE OF THE ABOVE MENTIONED NUMBERING SCHEME

In an Optical communication network, the numbering of nodes corresponds to placement of wavelength converters [6]. In an optical network, traffic congestion can be reduced by suitable placement of wavelength converters. In addition, flooding and loss of information packets is avoided and delay is reduced. [9,11]

V. CONCLUSION

We have presented a systematic method for numbering the nodes (assumed even) of a computer communication network when all the nodes lie on a straight line, are equispaced and the connectivity that is sought is even. After an exhaustive study and search, the authors have observed that this numbering scheme gives the cheapest starting network.

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