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Network Routing Problem in Multigraph

Siddhartha Sankar Biswas
Department of Computer Science and Engineering
Faculty of Engineering and Technology
Jamia Hamdard, New Delhi, INDIA

Abstract—This paper tries to find an easy method for solving the problem of routing in computer network where the network is using multigraph. This is done mainly using comparison of weight or cost of various multi arcs between any two nodes. This theory can be implemented in real life to solve Network Routing Problem in Multigraph.

Keywords— Multigraph, SPP, Routing, Data Communication and Technology

I. INTRODUCTION

Study of Theory of Graph [1, 2,3,4] has been exercised in immense volume of applications in many branches of Engineering particularly in Computer Engineering, Communication Engineering, Transportation Engineering, Networking Science, etc to list a couple of solely out of the many. 'Multigraph' is generalized version of 'graph' in which multiple links might exist between any of the two or more than two nodes [5, 6, 7, 8]. In a data communication network, multi-route features are very common.

It might happen that two neighbouring routers in a network topology might share multiple direct connections between them (one might be wired another might be wireless), so as to optimize the network traffic load as compared if a single link is used. Before proceeding further we would understand basic preliminaries of the theory of multigraphs. A multigraph G can be defined as an ordered pair (V, E) which consists of two independent sets V and E, where V is known as the set of nodes and E is known as the set of arcs. Theoretically multigraphs can be divided into two categories: undirected multigraphs and directed multigraphs.

In an undirected multigraph the edge (i, j) and the edge (j, i), if exist, are obviously identical unlike in the case of directed multigraph. But since we are trying to understand Application of Multigraph in Network Routing and for all practical purpose routing happens in directed way, so we will consider only directed multigraphs. For the purpose of understanding directed multigraph, let consider the following multigraph G1 (Fig 1) as shown where V = {A, B, C, D} and E = {AB, BD, DC, CA1, CA2, AD, CB1, CB2}.

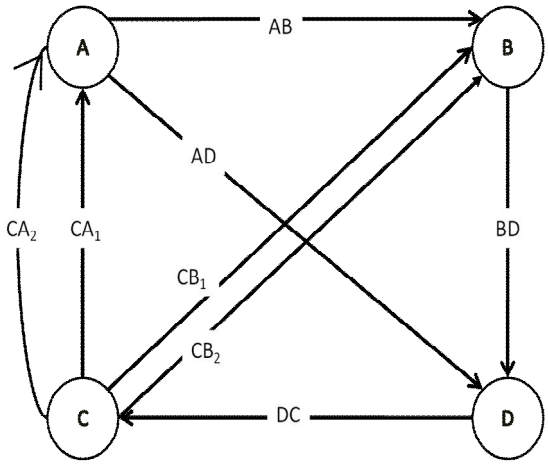

Fig 1 : Multigraph G_1

II. UNDERSTANDING THE PROBLEM OF MULTIGRAPH IN NETWORK ROUTING

Routing is the method of choosing best link for the purpose of data transfer in a network. Earlier, the term routing additionally meant forwarding network traffic among networks [9,10,11,12]. However, that latter perform is best delineated as forwarding. Routing is performed for several varieties of networks, as well as the tele-network (circuit switching), electronic knowledge networks (such as Internet), and transportation networks. this paper cares primarily with routing in electronic knowledge networks exploitation packet switch technology in am multigraph.To understand the how multigraph can be used in computer network, let us consider the following multigraph G2 as shown in Fig. 2.

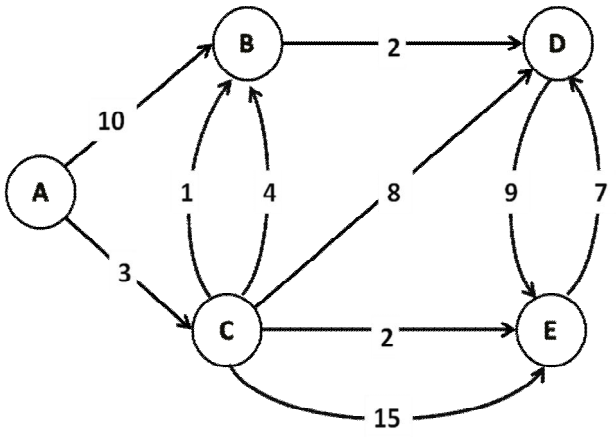

Fig.2 Multigraph G_2

Here the nodes set V = {A, B, C, D, E} represents routers and the numerical values given on the arcs are the weights or cost between each of these directed arcs. Traditional All Pair Shortest Path Problem(SPP) algorithms such as Matrix Multiplication Repeated Squaring, The Floyd-Warshall Algorithm and Transitive Closure of a Graph is applicable to only directed graph in general[20,21,22,23].

All these algorithm fell short to solve the same for directed multigraph. If the Multigraph G2 been a simple directed graph, it would been very easy to solve the problem by using any all pair Shortest Path Problem(SPP) algorithm. But as we can see the traditional algorithms cannot be used directly in this case. We therefore must find an effective way of solving Shortest Path Problem in a directed multigraph [13,14,15,16,17,18,19]. This would help us to implement the same in computer network routing.

III. UNDERSTANDING THE PROBLEM OF MULTIGRAPH IN NETWORK ROUTING

To solve the problem of routing in multigraphed network, let us first try to derive simple graph from the multigraph by comparing multi nodes between any two nodes, wherever they exist, such as between node C and node B, also between node C and node E.

By comparing all the nodes between which multiple nodes exist we first try to find the smallest of the given two arcs (might be even more than two in some other case).So by comparing the two nodes between node C and node B we will therefore consider the smallest of the two arcs which is of weight 1. Also by comparing the two nodes between node C and node E we will therefore consider the smallest of the two arcs which is of weight 2.As we can see the multigraph G2, can be converted into a directed graph G3 as shown below in Fig.3 .

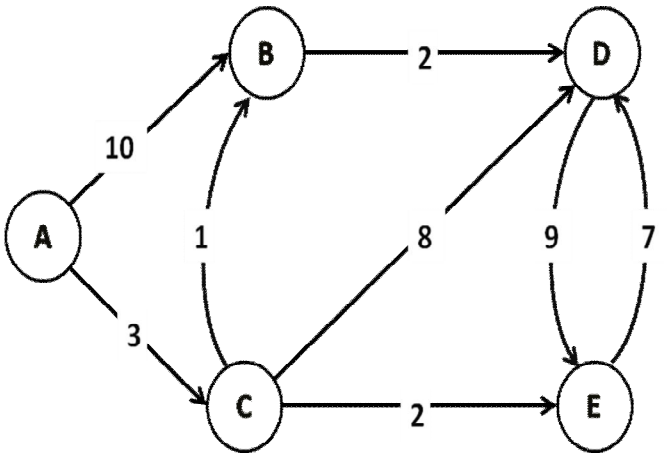

Fig.3 Graph G_3

Now we can easily apply Traditional All Pair Shortest Path Problem (SPP) algorithms such as Matrix Multiplication Repeated Squaring, The Floyd-Warshall Algorithm and Transitive Closure of a Graph .

IV. CONCLUSION

Multigraph a very important concept in the theory of graph. In communication network multigraph will play an important role. By using this method of deriving a simple graph from multigraph, we can easily implement routing in computer network.

In future we can try to extend our method to incorporate various aspects in networking such as node or router failure, link cut-off, etc and also incorporating bandwidth fluctuation by using the theory of fuzzy logic.

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