Distributed Routing Algorithms in Dynamic Wireless Networks

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Abstract: In this article, first wireless networks and their characteristics are introduced. Then distributed routing algorithms problem in these networks is investigated and their categorization is proposed. Afterwards, a distributed routing algorithm for dynamic wireless networks is suggested. This algorithm is from link reversal algorithm family and is highly adaptive. It is also efficient, measurable, and highly appropriate to use in large, compact, dynamic networks. The protocol used in this routing algorithm is Temporally-Ordered Routing Algorithm (TORA). [Azad Shojaei, Abdoljabar Asadi, Rahim rashidi, Distributed Routing Algorithms in Dynamic Wireless Network. *J Am Sci* 2012;8(7):335-337]. (ISSN: 1545-1003). http://www.jofamericanscience.org. 50

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1. Introduction

A wireless network can be considered as a set of routers that are capable of wireless sending and receiving, which move freely in an extent. The status of the communication, at any given time, is a function of their positions, transmission power, and interference level of channels. The mobility of the routers and the variability of their links are among factors that lead to a network with rapid and unpredictable topological changes. Having compact communication links is another characteristic of these networks. In these networks, wireless links inherently have significantly lower capacity than hardwired attachments and as a result are more exposed to congestion.

According to their characteristics, adopting shortest path algorithms in these wireless networks is not appropriate. These algorithms are more particularly designed for static or quasi-static networks where there are hardwired links. This algorithm may not be fast enough if the level of topological changes increases in the network. Most of these algorithms only provide a path between any source and destination, which results the problem of congestion to soar [5].

The introduced distributed routing algorithm in this article is flexible to topological changes of wireless networks. The reaction of the algorithm is organized as a temporally-ordered sequence. In this distributed algorithm, the reaction of the protocol to link failures is local. This favorable characteristic is gained by using the characteristic of physical or logical clock [1]. Some router algorithms that are proposed for wireless environments are as follow: Gafni Bertsekas (GB) algorithm, lightweight mobile routing (LMR) protocol, destination-sequenced distance vector (DSDV) routing protocol, wireless routing protocol (WRP), dynamic source routing (DSR) protocol. According to the brief explanation about wireless networks and router algorithms mentioned above, in following paragraphs distributed routing algorithms will be explained and in the last section the proposed algorithm is introduced.

2. Distributed Routing Algorithm

Communication sub-networks which include required hardware and software for data transmission between two network nodes are among important factors in a network. Circuit switching and packet switching are two main methods used in data transmission. According to the natural characteristic of traffic in networks, computers are more willing to use packet switching method. In networks using packet switching, messages are sorted in packets and by using saving and sending they are transmitted through the network. Choosing the next hop in the network using packet switching method to send the packet to is carried out according a decision making law called path-finding policy. According to the route changes caused by network traffic, path-finding policies in networks are categorized into two types of interruptive and adaptive ones. In interruptive policies, a packet from source I to source j is determined. In adaptive policies, the routs of the packets alter according to fluctuation and topological changes of the network. Based on how routes are processed, adaptive routing algorithms can be divided into two sorts of centered and distribute ones. In a centered algorithm, data are processed in a central node. In a distributed algorithm; however, data are processed on any node [4].

Distributed routing algorithms, in their turn, can be categorized into two types of distance vector algorithm (DVA) and link state algorithm (LSA).

3. Distributed Routing Algorithm in Dynamic Wireless Networks

The routing algorithm needs to have the following characteristics in order to operate in dynamic wireless environments [1]:

1. administering in a distributed manner,
2. presenting free loop routes,
3. presenting multiple routing (to reduce congestion),
4. building fast routes (some routes are likely not to be used after topological changes)
5. reducing communication congestion by localizing algorithm reaction to topological changes (by keeping bandwidth available and increasing measurability). Routing algorithm protocols for dynamic environments need to be designed in a way that they reduce reaction to topological changes of the network. A key concept in this design is to discriminate generating and distributing of wide (outrange) controller messages between topological changes of the network. The design of such protocols should be in a way that there would be no need to distribute controller messages all over the network after any changes in the network. By dividing the network; however, these messages are only generated for and sent to a small set of neighboring nodes in a part of the network involved in the changes. This distribution can occur periodically, at low cost, and independently from topological changes of the dynamic network. It can also be used as a capability to optimize and confirm the periodical routes and the soft state route, respectively [3].

The distributed algorithm only needs to access the information of the neighboring nodes such as the information of a hop. This guarantees that all routes are acyclic and provides each pair of source/destination, which requires a connection, with multiple routes [2]. For example, protocol LMR which is source-initiated and it provides a set of routes for a distinct destination in a required time.

4. Protocol

In explaining the protocol of this distributed routing algorithm for dynamic wireless environments, it should be noted that the network is defined as a graph like G=(N, L,), where N is a definite set of nodes and L is a set of initial undirected links. Any node i ϵ N has a particular identification named ID and any link (i,j) ϵ L has a double-sided connection.

Due to the mobility of the nodes, link sets change with time. New links form and old ones which have been invalid as a result of changes in the positions of the nodes disappear. For the neighboring links, a node is a breaking-down node where all the links of that node disappear. Any undirected link (i,j) ϵ L is likely to be one of these three types: undirected, directed from node i to j, directed from node j to i. If the link (i,j) ϵ L is a directed link from i to j, then nodes i and j will be upstream and downstream, respectively. For any i node, neighboring i nodes are from the set $N_i \epsilon$ N which is a set of nodes j as (i , j) ϵ L [1].

To continue the discussion, it is supposed that link level protocol exists which guarantees each node i is aware of its neighboring node in N_i. It is also assumed that all forwarded packets are received correctly and sequentially. Because mobile networks use omni-directional antennas, then it is supposed that when a node i sends a packet, this packet is distributed in all neighboring nodes in the set N_i.

5. The Base and Infrastructure of the Protocol

The protocol can be divided into three main functions: (1) creating routes; (2) maintaining routes; (3) erasing routes [1]. Creating a route from a source node to a destination requires establishment of a set of directed links from the source node to the destination. This function is only created when a node with no directed links wants to reach a destination. Therefore, creating routes is essentially related to assigning directions to links in an undirected network or a part of it, which finally leads to construction of a directed acyclic graph (DAG) with the root of the destination. Maintaining routes is directly pertinent to reacting to topological changes in the network in a way that routes form the nodes to the destination are re-generated in a limited time. By this token, it is clarified that the directed portion of an undirected network returns a destination-headed DAG within a short time. Two GB algorithms which are members of the main class in the designed algorithm for this work are presented in [6].

This algorithm is extremely efficient in reacting to the topological changes of the network. It can also distinguish a new portion of the network. This issue leads to the third part of the algorithm because after specifying the new part of the network all links in the old part divorced form the destination should turn into invalid links and be deleted from the sequence of communication links between the source and the destination.

The mentioned protocol carries out these three functions by using three different controlling packets: query packet (QRY), update packet (UPD), and clear packet (CLR). The QRY packet is used to create new routes. The UPD packet creates and maintains the routes in network parts. The CLR packet is applied to make the useless routes invalid and deletes them. Thorough explanation about creation and the main class of this algorithm and how to administer routing are presented in [1].

6. Conclusion

Wireless networks present new improvements in the field of mobile and dynamic networks, secure data transmission, and a mechanism for sharing data and services via electronic media without geographical limitations. Wireless dynamic networks have mobile nodes and their topology is changing dynamically, which requires specific routing algorithms. Based on dynamic characteristic of these networks, using distributed routing algorithms is an appropriate choice for routing process. These algorithms only require limited topological information which makes them more efficient compared to the algorithms requiring complete information of the network. The proposed algorithm in this article performs based on Temporally-Ordered Routing Algorithm (TORA) that is more flexible, efficient, and rapid compared to distributed shortest path algorithms.

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