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Hop by Hop Routing Problems in MANETs

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Abstract: Mobile networks have attracted huge interest in recent years because of their improved flexibility and reduced costs. Sending and receiving data packets between nodes is the main function of routing protocols. Because of the limited resource of mobile ad hoc network routing protocols is needed. Hop-by-hop routing means that routing decisions are made at each node independently and locally, based only on packets destination addresses and their route computation using corresponding topology knowledge. This paper introduced the difference between source routing and hop-by-hop routing and presented a lot of protocols that has been presented by different researchers. Also this paper presented the weakness of the paper that has been presented.

Keywords: Ad-hoc network, Source Routing, Hop-By-Hop Routing, MANET.

1 Introduction

Mobile networks can be classified into infrastructure networks and mobile ad hoc networks according to their dependence on fixed infrastructures. In an infrastructure mobile network, mobile nodes have wired access points (or base stations) within their transmission range. The access points compose the backbone for an infrastructure network. In contrast, mobile ad hoc networks are autonomously self-organized networks without infrastructure support. In a mobile ad hoc network, nodes move arbitrarily; therefore, the network may experience rapid and unpredictable topology changes. Additionally, because nodes in a mobile ad hoc network normally have limited transmission ranges, some nodes cannot communicate directly with each other. Hence, routing paths in mobile ad hoc networks potentially contain multiple hops, and every node in mobile ad hoc networks has the responsibility to act as a router [1]. A simple definition of routing is ”learning how to get from here to there.” In some cases, the term routing is used in a very strict sense to refer only to the process of obtaining and distributing information (”learning”), but not to the process of using that information to actually get from one place to another. Since it is difficult to grasp the usefulness of information that is acquired but never used, we employ the term routing to refer in general to all the things that are done to discover and advertise paths from here to there and to actually move packets from here to there when necessary. The distinction between routing and forwarding is preserved in the formal discussion of the functions performed by OSI end systems and intermediate systems, in which context the distinction is meaningful. In source routing, all the information about how to get from here to there is first collected at the source, which puts it into the packets that it launches toward the destination. The job of the intervening network is simply to read the routing information from the packets and act on it faithfully. In hop-by-hop routing, the source is not expected to have all the information about how to get from here to there; it is sufficient for the source to know only how to get to the ”next hop” (perhaps an intermediate system to which it has a working link), and for that system to know how to get to the next hop, and so on until the destination is reached. The job of the intervening network in this case is more complicated; it has only the address of the destination. Also hop-by-hop routing means that routing decisions are made at each node independently and locally, based only on packets destination addresses and their route computation using corresponding topology knowledge. The following figure shows one simple example of hop-by-hop SP routing decisions made by individual nodes independently

The resulting topology, shown in Figure 1, illustrates the real packet flows1 between each pair of nodes. The numbers associated with the arcs are the numbers of flows going through that particular link in that direction. In this paper, we investigate the hop by hop Shortest Path (SP)

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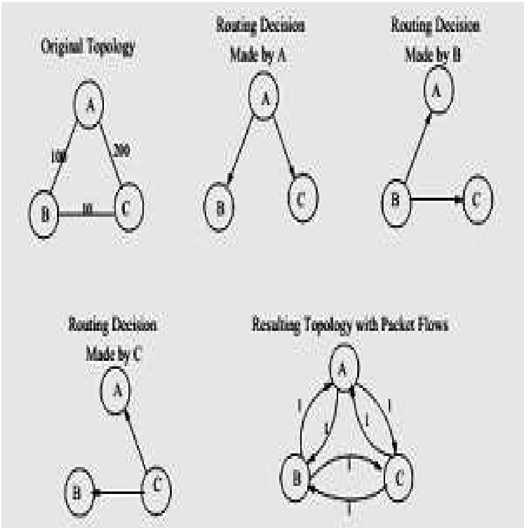

Fig. 1: An example of hop-by-hop SP routing: the numbers next to the links in the original topology denote link capacities, while the labels in the resulting topology denote ?flow? numbers.

routing problems in MANETs by presented a lot of researchers view and the methods that have been presented. The rest of the paper is organized as follows. Section 2 looked at literature survey. Section 3 problem formulation is presented. Conclusion is presented in section 4.

2 Literature survey

IP Multicast is facing a slow take-off although it is a hotly debated topic since more than a decade. Many reasons are responsible for this status. Hence, the Internet is likely to be organized with both unicast and multicast enabled networks. Thus, it is of utmost importance to design protocols that allow the progressive deployment of the multicast service by supporting unicast clouds. Lu?s Henrique M.

K. Costa et al [2] proposes HBH (Hop-By-Hop multicast routing protocol). HBH adopts the source-specific channel abstraction to simplify address allocation and implements data distribution using recursive unicast trees, which allow the transparent support of unicast-only routers. Additionally, HBH is original because its tree construction algorithm takes into account the unicast routing asymmetries. As most multicast routing protocols rely on the unicast infrastructure, these asymmetries impact the structure of the multicast trees. They show through simulation that HBH outperforms other multicast routing protocols in terms of the delay experienced by the receivers and the bandwidth consumption of the multicast trees.

P. Van Mieghem et al [3] presented the self-adaptive multiple constraints routing algorithm (SAMCRA), an improved and exact version of their QoS routing algorithm, the tunable accuracy multiple constraints routing algorithm (TAMCRA) they have investigated QoS routing in a hop-by-hop manner because it forms the basis of IP networking as e.g. in OSPF. In particular, they studied 'hop-by-hop destination based only' (HbHDBO) QoS routing that ignores the source and previous path history (as in current IP routing). They demonstrate that an exact QoS algorithm assures the avoidance of routing loops in this HbHDBO setting. However, despite the use of an exact QoS routing algorithm as SAMCRA, the exact solution cannot be guaranteed with HbHDBO routing. Fortunately, large simulation results on various sizes of random graphs show that the overall quality of the HbHDBO QoS routing is remarkably good. Finally, they show that, by using active networking as opposed to current IP routing, exact QoS routing in a hop-by-hop way can be guaranteed. Others used different number of nodes but didn't compare their algorithm with other algorithms.

Soumya Roy and J.J.Garcia-Luna-Aceves [4] presented a new path selection algorithm that enables correct path computation in routing protocols based on the exchange of link-state information on-demand and on hop-by-hop packet forwarding. As we now the traditional routing protocols based on link-state information form a network topology through the exchange of link-state information by flooding or by reporting partial topology information and compute shortest routes to each reachable destination using a path-selection algorithm like Dijkstra?s algorithm or the BellmanFord algorithm. However, in an on-demand link-state routing protocol, no one node needs to know the paths to every other node in the network. Accordingly, when a node chooses a next hop for a given destination, it must be true that the next hop has reported a path to the same destination; otherwise, packets sent through that node would be dropped. The researchers didn't use the constrained parameters to test the quality of the algorithm that has been presented. Also there isn't comparison with different protocols.

Jo o Luis Sobrinho [5] presented an algebra and algorithms for QoS path computation and hop-by-hop routing in the Internet. Network links and paths are characterized by generic weights, themselves a function of one or more metrics. A binary operation and an order relation are defined on the set of weights, and they are intertwined by the isotone property. He has shown that, within this framework, a generalized Dijkstra?s algorithm correctly computes lightest paths. On the other hand, without isotonicity , the generalized Dijkstra's algorithm does not determine lightest paths in general. His approach unites in a common framework QoS path computation algorithms that were previously scattered in the literature and provides insight into why some QoS paths cannot be computed with variants of Dijkstra's algorithm. Interestingly, isotonicity is also both necessary and sufficient for hop-by-hop routing. However, without strict isotonicity not every implementation of the generalized Dijkstra's algorithm results in loop-free hop-by-hop routing. In that case, nodes should compute lexicographic-lightest paths, which are a stronger form of lightest paths. He has presented the Dijsktra-old-touch-first algorithm which computes lexicographic-lightest paths, and, as such, is the first algorithm to guarantee loop-free hop-by-hop routing over general lightest paths. Moreover, the algorithm has the same complexity as a standard Dijkstra's algorithm. He concentrated on algebraic computations. But he didn't use any parameters to test the performance of the algorithm.

In Differentiated Service (DiffServ) networks, the routing algorithms used by the premium class traffic, due to the high priority a ordered to that traffic, may have a significant impact not only on the premium class traffic itself, but on all other classes of traffic as well. The shortest hop-count routing scheme, used in current Internet, turns out to be no longer sufficient in DiffServ networks. Jun Wang and Klara Nahrstedt [6] are studied the problem of finding optimal routes for the premium-class traffic in a DiffServ domain, such that (1) no forwarding loop exists in the entire network in the context of hop-by-hop routing; and (2) the residual bandwidth on bottleneck links is maximized. This problem is called the Optimal Premium class Routing (OPR) problem. They are proved that the OPR problem is NP-hard. They handled the OPR problem, by first; they analyze the strength and weaknesses of two existing algorithms (Widest-Shortest Path algorithm and Bandwidth-inversion Shortest-Path algorithm). Second, they propose a novel heuristic algorithm, called the Enhanced Bandwidth-inversion Shortest-Path (EBSP) algorithm. They prove theoretically the correctness of the EBSP algorithm, i.e., they show that it is consistent and loop free. Their extensive simulations in different network environments show clearly that the EBSP algorithm performs better when routing the premium traffic in complex, heterogeneous. The algorithm that has been proposed must be test in different environments with different parameters.

As the development of the Internet continues, congestion control has become a big issue to the computer network society. Most congestion control schemes fall into two categories, end-to-end and hop-by-hop schemes. Shu-Ching Chen et al [7] proposed a novel hop-by-hop algorithm that originates from a classical traffic control algorithm. The experimental results show that their proposed algorithm can achieve short delays and quick responses to the congestion situations and cause no packet loss. It can also minimize the bandwidth requirement and achieve a very high buffer usage level for nodes along the transmission path. The researchers didn't used parameters criteria like load balance or topology changes and network density.

Wireless Mesh Network (WMN) has become an important edge network to provide Internet access to remote areas and wireless connections in a metropolitan scale. In this paper, Ronghui Hou et al [8] studied the problem of identifying the maximum available bandwidth path, a fundamental issue in supporting quality-of-service in WMNs. Due to interference among links, bandwidth, a well-known bottleneck metric in wired networks, is neither concave nor additive in wireless networks. they propose a new path weight which captures the available path bandwidth information. they formally prove that their hop-by-hop routing protocol based on the new path weight satisfies the consistency and loop-freeness requirements. The consistency property guarantees that each node makes a proper packet forwarding decision, so that a data packet does traverse over the intended path. Their extensive simulation experiments also show that their proposed path weight outperforms existing path metrics in identifying high-throughput paths.

Nithin Michael and Ao Tang and Dahai Xu [9] developed HALO, the first link-state, hop-by-hop routing algorithm that optimally solves the traffic engineering problem for intra-domain routing on the internet. The algorithm uses exactly the same information as OSPF. Furthermore, the link weights can be computed locally by routers and the algorithm automatically reacts to traffic demand changes by adjusting router split ratios. Their solution can adapt to changing traffic patterns automatically. The optimality of the algorithm is proved theoretically and also verified numerically. There are still important areas to be explored. For instance, the convergence rate of the algorithm needs to be analyzed. Another interesting direction involves using time averages for the link-states in order to test how well the algorithm performs without synchronous updates. Energy inefficiencies in current networks provide both challenges and opportunities for energy saving. Recently, there are many works focusing on minimizing energy cost from the routing perspective. However, most existing work view them as optimization problems and solve them in a centralized manner such as with a solver or using approximations.

Chenying Hou et al [10] focus on a network-wide bi-objective optimization problem, which simultaneously minimizes the total energy consumption using speed scaling and the total traffic delay. They propose a hop-by-hop dynamic distributed routing scheme for the implementation of this network-wide optimization problem. Their scheme is more practical to realize in large distributed networks compared with current centralized energy minimization methods. they can also achieve near global optimal in a distributed manner, while most used shortest path routing protocols such as OSPF cannot make it. Their routing scheme is totally distributed and maintains loop-free routes in every instant. Simulations conducted in real data sets show that the distributed loop-free routing scheme converges to near Pareto optimal values. Also, their method outperforms the widely applied shortest path routing strategy by 30

Nithin Michael, Ao Tang and Dahai Xu [11] proposed a new sub-optimal distributed link-state routing protocols with hop-by-hop forwarding like OSPF and IS-IS are the dominant intra-domain routing solutions on the Internet. These algorithms have become global as their potentially very large performance loss because of the volcanic growth of the Internet.

The main idea of these schemes is to centrally assign weights to links and locally calculate shortest paths this made them easier to implement and manage compared to the optimal solutions that had been proposed. Some of the lost performance was getting back through extensive capital cost. For instance, due to the poor resource utilization resulting from these protocols, many of the 'backbone' links of the internet are so over-provisioned to support peak traffic that they run at very low utilizations on average.

Unsurprisingly, the search for an optimal routing algorithm that has the same ease of management and implementation as OSPF has continued unabated. They presented HALO (Hop-by-hop Adaptive Link state Optimal) algorithm. For our knowledge, some algorithms depending on hop by hop routing like OLSR, AODV and HALO.

3 Problem Formulation

One critical issue for routing in MANETs is how to select reliable paths that can last as long as possible since radio links may be broken frequently. The reliability of a path depends on the number of links and the reliability of each link constituting the path. Many routing metrics in terms of number of links have been proposed, such as the shortest path and hop-by-hop routing. Hop-by-hop routing selects a path having next hop to forward the data to next node. Hop-by-hop route selection may be done on the basis of different parameters like transmission cost which can be calculated on the basis of next node information, link stability factor, power consumption factor etc. Performance of the network can be enhanced through the routing that has been determined but it also depends upon the functionality of the routing protocol and the parameters selected for the route.

4 Conclusion

Mobile Ad Hoc Network (MANET) is a collection of wireless mobile nodes that are able to dynamically form a temporary network without any fixed infrastructure or centralized administration. In this paper, a brief survey on hop by hop routing has been introduced. Different researchers discussed various solutions and each researcher used a different parameter and methods for the hop by hop for routing. So we are conclude that the result of the hop by hop routing also depends upon the selected parameters and as well as on the selected routing protocols used for ad hoc network. Each author worked on a specific hop by hop routing but no one has considered all the parameters in a particular solution and no one compared it with source routing protocols.

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