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A Review on Cooperative Multicast Routing in Mobile Ad-hoc Network

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ABSTRACT
Multicast is a dissemination technique of paramount importance in wireless ad hoc networks. The multicast scheme is widely used within routing protocols by a wide range of wireless ad hoc networks such as mobile ad hoc networks, vehicular ad hoc networks, and wireless sensor networks, and used to spread emergency messages in critical scenarios after a disaster scenario and/or accidents. In this paper we present the study about the cooperative multicasting which focuses on the one to many communications in mobile ad-hoc network using various protocols.

Keywords: Mobile ad-hoc networks, Multicasting, wireless sensor networks, Protocol, wireless mobile network.

INTRODUCTION

Mobile ad hoc network (MANET) is a dynamic, wireless network that consists of numerous mobile nodes communicating with each other directly or indirectly without any preexistent infrastructure support. MANETs is an easily deployable, self-creating and self-configurable, fault resilient, mobile and flexible type of network and finds its applications in various infrastructure-less environments like the military battlefield, emergency services like search and rescue operations, disaster recovery operations, location aware systems, vehicular networks, multi-player games and teleconferencing (audio/ video) [11].

Broadcasting is a widely used dissemination technique in which nodes send out the same information simultaneously to all their neighbors. Broadcasting is used in ad hoc networks such as Wireless Sensor Networks (WSNs), Mobile Ad Hoc Networks (MANETs), and Vehicular Ad Hoc Networks (VANETs). In routing protocols for ad hoc networks, broadcasting is part of the discovery phase, which is responsible for finding a communication path to route the application data from a source node to one or more destination nodes (unicast or multicast routing protocols [9].

In MANETs, the frequent changes of the topology due to the motion of nodes usually have a negative impact on system performance metrics, such as network delay and data delivery ratio. And those changes also bring fundamental challenges to both protocol design and performance analysis. On the other hand, it as proved if the mobility is properly exploited, the node mobility can also improve certain performance metrics of system, e.g., network capacity and connectivity. MANETs are scalable in terms of Uni-cast capacity with assistance of mobility. However, the capacity in static ad hoc networks is not scalable without the help of advanced physical-layer techniques, e.g., cooperative MIMO communications. In fact, such significant gain is obtained at the cost of a very large delay. Since capacity and delay are both paramount metrics in some applications of MANETs, it is necessary to examine relationships between them and they are the capacity-delay tradeoffs [5].

Adhoc means ”for the purpose”, self-organizing network architecture. There is no requirement of base station. Adhoc networks are further classified as Mobile Adhoc Networks (MANETs), Vehicular Adhoc Networks (VANETs), Wireless Sensor Network (WSN), Wireless Mesh Network (WMN). Here, we focus on routing protocols for MANETs. Routing protocols for MANETs can be categorized on the basis of mechanism as reactive (routes are created on demand), proactive (pre-determined routes are stored in routing tables and are periodically updated) and hybrid (some nodes have predefined and some have on-demand). In terms of number of destinations, that a protocol can transmit data for a given source, routing can be Uni-cast (only one destination supported) or Multicast (for group of destinations) [14].

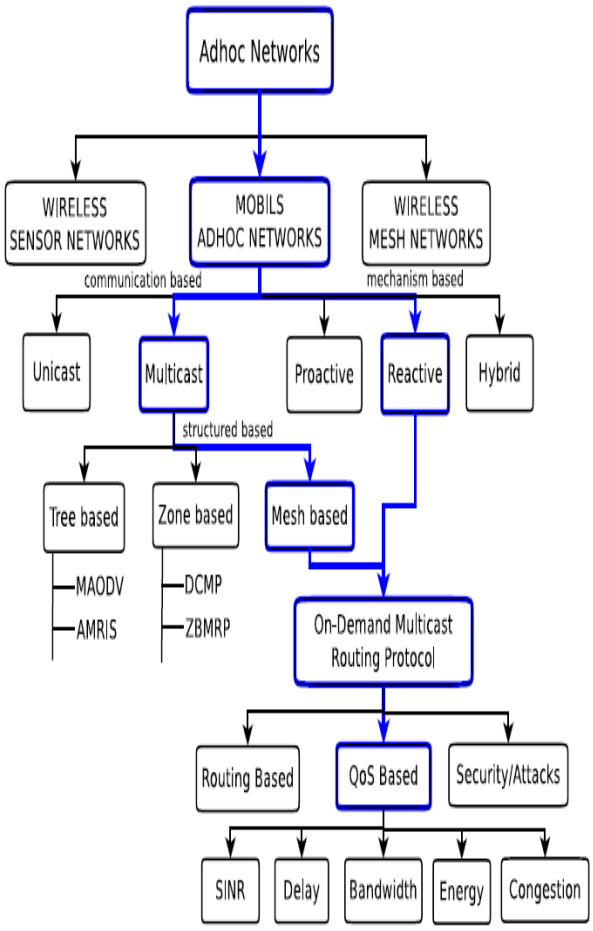

Fig. 1: Taxonomy of Routing Mechanism in MANETs [14].

Multicast in mobile ad hoc networks (MANETs) is important for supporting many critical applications with one-to-many communications [1], like message exchanges among a group of soldiers in battlefield, earthquake alarming, video conferencing, etc. Cooperative multicast serves as an efficient communication paradigm, where destination nodes may share their packets with each other. In practice, however, a destination node may act selfishly and refuses to forward packets to other nodes due to its limit power resource.

Most of the routing protocols proposed, so far, are based on hop-count metric. They consider minimum hop count path, i.e., shortest path as the feasible one and ignore the stability concerns. Link stability is the capability of a link to stay connected for a longer duration. Longer is the link duration, higher is the stability of a link. Link stability gets affected by node mobility, available bandwidth, residual energy of nodes, etc. These factors may lead to link breakage and route reconfiguration. Therefore, a more stable path should be preferred over a shortest path [11].

Ad-hoc networks are characterized by the need of infrastructure, and by a random and quickly varying network topology; thus for a robust dynamic routing protocol that can accommodate such an environment. Therefore, many routing algorithms have come into existence to satisfy the needs of communications in such networks. To name two routing algorithms are AODV, from the immediate family and DSDV, from the proactive family. Both protocols were simulated using the ns-2 and were compared in terms of average throughput, packet loss ratio, and routing overhead, while changeable number of nodes, speed and pause time. Simulation exposed that although DSDV completely scales to small networks with low node speeds, AODV is favored due to its more efficient use of bandwidth [13].

The rest of this paper is organized as follows in the first section we describe an introduction of about the wireless sensor network. In section II we discuss about the rich literature for the

multicasting in mobile ad-hoc networks. In section III we discuss about the DSR protocol, finally in section IV we conclude the about our paper which is based on the literature survey and specify the future scope.

II RELATED WORK

In recent years many works have done on routing protocol in mobile ad hoc networks. In the following we review some of this works related with our work.

[1] This paper proposed a general cooperative multicast scheme to fully consider the important issue of destination nodes' cooperative behaviors. A Markov chain theoretical model was developed to depict packet delivery process under the general scheme, based on which and some related basic probabilities, analytical expressions were derived for the packet delivery probability/cost. Extensive simulations illustrate that our theoretical models can accurately predict the packet delivery probability cost performance under the general scheme.

[2] In the proposed scheme, the ad-hoc users can actively employ cooperative diversity techniques to improve the cellular network downlink throughput. As a reward, a fraction of the cellular network spectrum is released to the ad-hoc network for its own data transmission. To determine the optimal spectrum allocation, they maximize the ad-hoc transmission capacity subject to the constraints on the outage probability of the ad-hoc network and on the throughput improvement ratio of the cellular network. Both the transmission capacity of the ad-hoc network and the average throughput of the cellular network are analyzed using the stochastic geometry theory.

[5] In this paper, we focus on the asymptotic capacity and delay, and their tradeoffs in mobile ad hoc networks (MANETs). As we all know, some fixed rate communication models such as the protocol model and the physical model have been studied in the past. However, their work aims to investigate the impact of an adaptive rate communication model on capacity-delay tradeoffs in MANETs under classical mobility models. Specifically, we adopt a well-known adaptive rate model called the generalized physical model (GphyM). The mobility of nodes is characterized by two broad classes of practical mobility models and they are hybrid random walk models and discrete random direction models.

[6] In this paper, a cooperative multicast protocol named MWN Cast is proposed based on a novel moving window network coding technique. They develop analytical models and show three properties of the proposed scheme. Based on this technique, they further present the MWN Cast protocol to address the bottleneck problem in wireless multicast through cooperative relays. Analytical results show that without explicit feedback, the packet recovery loss probability of the receivers drops almost exponentially with the increase of window size.

[7] In this paper, they focus on the capacity and delay tradeoff for multicast traffic pattern in Cognitive Radio (CR) Mobile Ad-hoc Networks (MANET). In our system model, the primary network consisting of n primary nodes, overlaps with the secondary network consisting of m secondary nodes in a unit square. Assume that all nodes move according to an i.i.d. mobility model and each primary node serves as a source that multicasts its packets to kp primary destination nodes whereas each secondary source node multicasts its packets to ks secondary destination nodes. Under the cell partitioned network model, we study the capacity and delay for the primary networks under two communication schemes: Non-cooperative Scheme and Cooperative Scheme.

[8] In this work, they propose a network coding based solution to enable MHs which are not neighbors to cooperate indirectly. They formulate the Maximum Channel Efficiency Encoding (MCEE) problem by introducing network coding and cooperative caching techniques in on-demand data broadcast environments. They prove that MCEE is NP-hard by constructing a polynomial-time reduction from the Minimum Clique Cover (MCC) problem. Further, they propose two schemes (NCM and NCB) for on-demand data broadcasting using network coding. In each scheme, they propose two algorithms running at

the MSS and MHs for making encoding decisions and decoding requested data items, respectively. They build the simulation model for performance evaluation and the simulation results demonstrate that the proposed schemes not only increase the bandwidth efficiency of the limited downlink communication channel, but also enhance the system performance by reducing the data access latency.

[9] In this paper, they have highlighted the importance of broadcasting techniques in the performance of wireless ad hoc networks, showing that probabilistic broadcast methods exhibit suitable performance in mobile conditions, emergency situations, and in scenarios with limited resources. In addition, they analyzed the methodology followed by researchers to evaluate the probabilistic broadcast techniques, considering factors like networks simulators, performance metrics, and real implementations. According to the reviewed literature, simulation is still the main method for evaluating broadcast schemes in ad hoc networks, only some works presented experimental results that indicate the existence of some differences from the simulation results with respect to the experimental results.

[10] In this paper, the target is to provide a stable routing protocol with high efficiency for these kinds of networks, by improving the DSR routing protocol. In the provided protocol, beside the path stability, the energy of the path nodes and path length will be considered too, in order to discover a path with higher quality and use it. The provided protocol will be called as ST-DSR. The result of stimulation in the NS-2 environment shows that the ST-DSR has a better operation toward the base protocol, meaning DSR.

[11] The objective of the present paper is to introduce a QoS aware routing metric that determines a reliable forwarding node based on Link Stability cost Function (LSF). The principle theme underlying our protocol is optimum contention count that can be estimated with the help of received signal strength. Their proposed protocol has been demonstrated on an existing mesh-based Multicast routing protocols, ODMRP. Simulations are carried out on Exata/Cyber simulator, and obtained results are compared with that of ODMRP. The comparative analysis reveals that their protocol is more efficient in contrast to ODMRP, LSMRP and MMRNS, regarding performance parameters like PDR, latency and route lifetime.

[12] They proposed an energy-aware multipath routing scheme based on particle swarm optimization (EMPSO) that uses continuous time recurrent neural network (CTRNN) to solve optimization problems. CTRNN finds the optimal loop-free paths to solve link disjoint paths in a MANET. The CTRNN is used as an optimum path selection technique that produces a set of optimal paths between source and destination. In CTRNN, particle swarm optimization (PSO) method is primly used for training the RNN. The proposed scheme uses the reliability measures such as transmission cost, energy factor, and the optimal traffic ratio between source and destination to increase routing performance.

[13] They propose an agent based congestion control technique for WANETs. In their technique, the information about network congestion is collected and distributed by wireless agents (WA). A wireless agent based congestion control AODV routing protocol is proposed to avoid congestion in ad-hoc network. Some wireless agents are collected in ad-hoc network, which carry routing information and nodes congestion status. When wireless agent movements happen through the network, it can select a less loaded neighbor node as its next hop and update the routing table according to the node's congestion status.

[14] This paper discusses the state of the art research in mesh based multicast routing protocols in MANETs. From discussions as presented earlier, it can be inferred that selecting QoS metric for the specific problem domain is significant especially in MRP. A suitable QoS metric is useful in assessing "goodness" of a routing solution as per requisite performance. Various enhancements in ODMRP have been discussed on the basis of routing modifications and Quality of Services parameters.

[15] In this paper the performance of five most used routing protocol are compared. The routing protocols consider in this comparative analysis are Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV), On-demand Distance Vector (AODV), Zone Routing Protocol (ZRP), and Temporally Ordered Routing Algorithm (TORA). In order to analysis the performance of these protocol, which are implemented with same configuration and performed for same a common objective. Then the performance such as sent packets, received packets, packet delivery ratio, throughput, average end to end delay, packets dropped, sending jitter and receiving jitter are analyzed.

III DSR PROTOCOL

Dynamic Source Routing Protocol is one of the demand-driven routing protocols based on resource routing. Additionally, nodes do not need to distribute their routing tables to the neighboring nodes, which save a lot of network bandwidth. Another important issue of the DSR protocol is that whenever there is a failure link, the RERR packet is released to the original source, which initiates the path detection process at the new turn. The link cannot be restored locally. Two main phases are considered for this protocol: route detection and path updates. The route discovery phase uses the packets of request and response, and the route update phase uses acknowledgments and link errors. The DSR protocol is a proactive protocol that can manage source routing networks without the need for routing tables and updating them. In the DSR protocol, the sender specifies all of the source paths to the destination and stores all the middle nodes in the packets. This protocol operates on the basis of link state algorithms, meaning each node can store the best route to the destination. Also, if a change occurs in the network, all network nodes are notified through the general flooding of this change [10].

IV CONCLUSIONS AND FUTURE SCOPE

In MANETs, the frequent changes of the topology due to the motion of nodes usually have a negative impact on system performance metrics, such as network delay and data delivery ratio. And those changes also bring fundamental challenges to both protocol design and performance analysis. The delay and capacity in MANETs depend on the properties of the mobility models assumed. In this paper we discuss the comparative study for the multicasting in mobile ad-hoc network in future we plan to solve the destination node behaviour problem in network.

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