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A STUDY ON LOCAL BROADCAST ALGORITHMS FOR REDUCING THE NUMBER OF TRANSMISSIONS IN WIRELESS ADHOC NETWORKS

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ABSTRACT:
A Mobile Ad hoc network (MANET) is a system of wireless mobile nodes that dynamically self-organize in arbitrary and temporary network topologies. In MANET, nodes can directly communicate with all other nodes within their radio ranges. The nodes that are not in the direct communication range use intermediate nodes to communicate with each other. Local broadcast algorithm is used to reduce the number of retransmission. In local broadcast algorithm a node can exchange information between neighbors to forward all the data packets. A node randomly chooses the packet that are required for its neighbors. This paper presents a study of local broadcast algorithm in wireless ad hoc network.

Keywords: *Mobile ad hoc network; local broadcast algorithm; connected dominating set.*

1. INTRODUCTION

A mobile ad-hoc network (MANET) is a self-configuring infrastructure-less network. MANETs are mobile, they use wireless connections to connect various networks. Broadcasting is a fundamental communication primitive in which a message is sent from a source node to all other nodes in the network. In general, broadcasting refers to a process of transmitting a packet so that each node in a network receives a copy of this packet. The simplest broadcast mechanism is flooding, in which every node retransmits the first copy of the received message to all of its one hop neighbors. Flooding is the simplest approach for broadcasting where every node in the Network forwards the packet exactly once. Flooding ensure the full coverage of the entire network [1].

The rest of this paper will be structured as follows. Section 2 describes about broadcasting. Section 3, presents connected dominated set. Section 4, presents survey of existing local broadcast algorithm finally the conclusion is discussed in Section 5.

2. BROADCASTING IN MANET

Broadcasting refers to a process of transmitting a packet so that each node in a network receives a copy of the packet. Broadcasting is classified into two types

- **Probabilistic**
- **Deterministic**

2.1. Probabilistic

In probabilistic approach the packets received by each node is forward with probability *p*. The value *p* is determined by appropriate information gathered at each node. The probabilistic approach provides a good result, but it cannot guarantee the full coverage because some nodes will not receive broadcast the message. Other probabilistic approaches are

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- **Counter-based**
- **Distance-based**
- **Location-based**

2.1.1. Counter-based scheme

The node initiates a timer and a counter at the time of broadcasting. The counter increases one for each received redundant packet. When the timer expires, if the counter is larger than the value of threshold, the node will not rebroadcast the packet; if not the node will broadcast the packet.

2.1.2. Distance-based scheme

The node initiates a timer. Before the timer expires, the node checks the location of the senders of each received packet. If some sender is closer than a distance value of a threshold, the node will not rebroadcast the packet. If not the node rebroadcasts the packet.

2.1.3. Location-based scheme

The node initiates a timer and accumulates the coverage area that has been covered by the arrived packet. When the timer expires, if the accumulate coverage area is larger than the value of threshold, the node will not rebroadcast the packet. If not the node will broadcast it.

2.2. Deterministic algorithms

In deterministic approach provide full coverage of the network for a broadcast operation, the subset of nodes forward the broadcast packet and the remaining nodes are adjacent to the nodes that forward the packet.

Other deterministic approaches are

- **Global**
- **Quasi-global**
- **Quasi-local**
- **Local**

2.2.1. Global

Broadcast protocols, centralized or distributed, are based on global state information. Broadcast protocols use either global information to derive a small forward node set in the worst and average cases. However, global protocols are costly in terms of the number of rounds of sequential information. Propagation needed to distribute state information or to establish a global infrastructure such as a spanning tree.

2.2.2 .Quasi-global

Distributed broadcast protocols are based on partial global state information. In the global broadcast protocol, quasi-global broadcast protocols do not need to collect the whole global state. Only limited global state information is collected.

2.2.3. Quasi-local

Distributed broadcast protocols are based on mainly local state information and occasional partial global state information. The cluster approach falls into the quasi-local model. Cluster structure be a two-level hierarchical formation and it is formed by first electing a cluster head and, then, its neighbors joining in the cluster as non-cluster head members.

2.2.4. Local

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Distributed broadcast protocols are based on solely local state information. The local broadcast protocol is based on solely local information without exhibiting any sequential propagation of state information. It also support locality of maintenance. It does not guarantee performance in the worst case such as a constant approximation ratio.

Other local approaches are

- **Self pruning**
- **Neighbor designating**

2.2.4.1.Self pruning

Each node in this approach is required to have knowledge of its neighbors which could be achieved through the periodic Hello messages. The receiving node will first of all compare its neighbors list to its sender's list and will rebroadcast if the additional nodes could be reached, otherwise the message will be dropped. Self pruning is the simplest method in the simple flooding protocol of neighbor knowledge.

2.2.4.2. Neighbor designating

In neighbor designating algorithm each node selects the status of the forwarding node. The challenge here is to choose a smallest subset of nodes to forward the message. With the 1-hop neighbor information the subset of forwarding nodes can be selected [1].

2.3. Local broadcasting approaches

2.3.1. Broadcasting using the static approach

Based on static approach the local broadcast algorithm can achieve constant approximation factor and shortest path preservation if the nodes are provided with position information. In the static approach, using local algorithms any local topology changes can affect only the status of the nodes in the locality. Static approach use a priority function known by all other nodes in order to determine the status of each node. The status of each node does not depend on other nodes.

2.3.2. Broadcasting using the dynamic approach

In the dynamic approach, the status of each node is determined "on-the-fly" during the broadcast progress. Using this approach, the construct CDS may vary from one broadcast instance to another even when the whole network topology and the source node remain unchanged. As a result the broadcast algorithms based on the dynamic approach typically have small maintenance cost and are expected to be robust against node failures and network topology changes.

3. CONNECTED DOMINATING SET

In Connected dominating set (CDS) nodes are selected to forward the broadcast packets during the flooding process, and the information flooded in the network. Routing based on a connected dominating set is a commonly used approach, wherever the searching space for a route is reduced to nodes in the set. A set is dominating if each and every one of the nodes in the system is either in the set or neighbors of nodes in the set.

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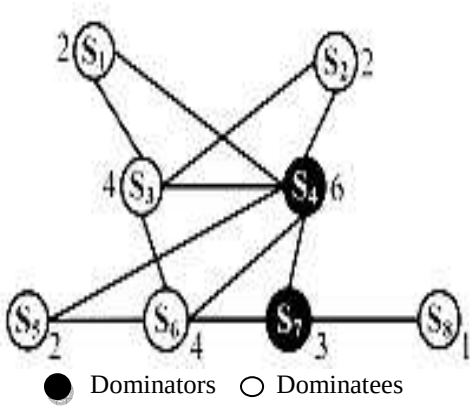

Figure 1: Connected Dominating Set

In the above example the connected dominated set are S1 to S8. By using a connected dominating set all nodes will broadcast a message to each other. S4, S7 are selected as dominators to form a connected structure. Whereas remaining nodes such as S1, S2, S3, S5, S6, S8 are dominatees which are always far from its dominators.

3.1. Advantage of CDS

The advantage of connected-dominating-set-based routing is that it centralizes the whole network into small connected dominating set sub network, which means only gateway hosts keep routing information, so that as long as network topological changes do not affect this sub network there is no need to recalculate routing tables [2].

4. STUDY OF RELATED WORKS

Several researchers have investigated the area of local broadcasting algorithm in Manet.

Ali Kies et al. [1] Proposed distributed algorithm computes the connected dominating set (CDS) based on node energy and node connectivity. In the CDSEP (Connected Dominating Set energy Protocol), the CDS nodes are selected to forward broadcast packets during the flooding process, and the information flooded in the network through these CDS is also about the CDS. Optimization is achieved by minimizing the contents of the control packets flooded in the network.

Aminu Mohammed et.al [2] proposed a pure probabilistic approaches to mitigate the problem inherent with flooding, when a mobile nodes rebroadcast a message with a probability which can be fixed or computed based on the local density. However, the approaches reduce the number of rebroadcasts at the expense of reachability. The counter-based approaches inhibit a node from broadcasting a packet based on the number of copies of the broadcast packet received by the node within a random access delay time.

Chih-Shun Hsu and Yu-Chee Tseng et.al [3] proposed an efficient reliable broadcasting protocol for the potential broadcast storm problem that could occur in the medium access level. The Existing protocols are either unreliable or reliable but based on a too costly approach. Our protocol differs from a low-cost broadcast does not guarantee reliability, as basic operation.

Fei Dai and Jie Wu [4] proposed an enhanced version of the generic protocol self-pruning broadcast protocol, in which a node may not forward a broadcast packet if a certain self-pruning condition is satisfied based on the neighborhood information. Here static network with an ideal MAC layer a subset of nodes forward the broadcast packet and still guarantee the complete network delivery.

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Hai Liu, et al [5] proposed an efficient flooding algorithm that achieves the local optimality in two senses: 1) the number of forwarding nodes in each step is the minimal; 2) the time complexity for computing forwarding nodes is the lowest. Which is O (n log n), where *n* is the number of neighbors of a node.

Ivan Stoimenovic et.al [6]; proposed a localized dominating set which significantly reduce or eliminate the communication overhead of a broadcasting task by applying the concept of localized dominating sets. The maintenance does not require any communication overhead in addition to maintaining positions of neighboring nodes. Retransmissions only by internal nodes in a dominating set is sufficient for reliable broadcasting. proposed techinque eliminate neighbors that already received the message and rebroadcast only if the list of neighbors that might need the message is nonempty.

Jie Wu and Hailan Li [7] proposed an efficient routing among a set of mobile hosts (also called nodes) is one of the most important functions in ad-hoc wireless networks. Routing based on top of a connected dominating set is a commonly used approach, wherever the searching space for a route is reduced to nodes in the set.

Jie Wu and Fei Dai [8] proposed an approach is based on selecting a small subset of nodes to form a forward node set to carry out a broadcast process. The status of every node, forward or non forward, is also determined by the node itself or by other nodes. Node status can be determined by using different snapshots of network state along time (called views) without causing problems in broadcast coverage. The forward node set can be constructed and maintained through either a proactive process (i.e., “up-to-date”) before the broadcast process or a reactive process (i.e., “on-the fly”) during the broadcast process.

Jie Wu and Fei Dai [9] proposed a general framework for broadcasting in ad hoc networks through self-pruning. It is based on selecting a small subset of nodes to form a forward node set to carry out a broadcast process. Each node, receives a broadcast packet, determines to forward the packet. The forward node set is selected through a distributed and local pruning process.

Julien Cartigny and David Simplot et.al [10] proposed a new localized protocol where each node requires only the knowledge of its distance to all neighboring nodes and distances between its neighboring nodes each node can adjust its transmission power in order to minimize total energy consumption but still enable a message originated from a source node to reach all the other nodes in an ad-hoc wireless network.

Khabbazian et al. [11] proposed an efficient sender-based broadcasting algorithm based on 1-hop neighbor information that reduces the time complexity of computing forwarding nodes to O(n). Also, proposed a simple and highly efficient receiver based broadcasting algorithm.

Luc Hogie and Pascal Bouvry et al [12] proposed a new broadcasting protocol called Delayed Flooding with Cumulative Neighborhood (DFCN). DFCN enables bandwidth-efficient broadcasting in wide area network composed of large number of mobile devices.

Mahtab Seddigh et.al [13] proposed scheme reduce the communication overhead of broadcasting algorithm for one-to-one model by applying the concepts of planar graphs such as RNG (relative neighborhood graphs) and connected dominating sets determined by internal nodes.

P.Visu et al. [14] proposed two broadcasting algorithms like Sender based algorithm and Receiver based algorithm.The proposed Sender based algorithm choose subset of forwarding nodes using 1-hop neighbor information. It know how to reduce both the computational complexity of selecting the forwarding nodes and the maximum number of selected nodes in the worst case. The proposed receiver base broadcasting algorithm can significantly decrease redundant broadcasts in the network.

Peng Wei and LU Xicheng [15] proposed Ad Hoc Broadcast Protocol (AHBP). In which, messages are only rebroadcast by broadcast relay gateways that constitute a connected dominating set of the network. AHBP efficiently reduce the redundant messages.

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Ramalakshmi and Radhakrishnan [16] proposed a distributed algorithm for energy efficient stable MPR based CDS construction to extend the lifetime of ad hoc wireless networks by considering energy and velocity of nodes. The route discovery protocol make use of the CDS nodes to relay route request messages.

Shuhui Yang et.al; [17] proposed scheme using a directional antenna, forwarding nodes are selected locally only need to transmit broadcast messages. The first extension applies network coding to both dynamic and static forwarding node selection approaches. In the second extension, two approaches for the single source/single message issue in the network coding-based broadcast application.

Wei Lou and Jie Wu [18] proposed a simple broadcast algorithm to provide high delivery ratio. Among 1hop neighbors the sender, only selected forward nodes will send acknowledgements to conform their receipt of the packet. Forward nodes are selected in such a way that all the sender's 2-hop neighbors are covered. The sender will resend the packet until the maximum number of retries is reached.

Wei Peng Xi-Cheng Lu [19] proposed an efficient approach to reduce the broadcast redundancy. In their approach, local topology information and the statistical information about the duplicate broadcasts are utilized to avoid unnecessary rebroadcasts.

Wei Lou, and Jie Wu [20] In this scheme, proposed analyze some deficiencies of the dominant pruning algorithm and propose two better approximation algorithms: total dominant pruning and partial dominant pruning. The above two algorithms utilize 2-hop neighborhood information more effectively to reduce redundant transmissions.

Wei Lou and Jie Wu [21] proposed reliable broadcast algorithm, called double-covered broadcast (DCB), takes advantage of broadcast redundancy to improve the delivery ratio in the environment that has rather high transmission error rate. Only selected forward nodes retransmit the broadcast message. Forward nodes are selected here such a way that (1) the sender's 2-hop neighbors are covered and (2) the sender's 1-hop neighbors are either a forward node, or a non-forward node. The retransmissions of the forward nodes are received by the sender as confirmation of their receiving the packet.

Ying Cai, et al. [22] proposed a new flooding technique called Edge Forwarding. The new method minimizes the flooding traffic by leveraging location information to limit broadcast retransmission to only hosts near the perimeter of each broadcast coverage. Edge Forwarding requires each host to track only neighboring nodes within its one-hop distance.

Yu-Chee Tseng Sze-Yao Ni [23] proposed multihop mobile ad hoc network, in which broadcasting is an elementary operation to support many applications. Several threshold-based schemes are shown to perform better than flooding proposed several adaptive schemes, can dynamically adjust thresholds based on local connectivity information.

5. CONCLUSION

The presented local broadcast algorithms have several advantages. It is highly efficient in reducing unnecessary packet retransmissions by allowing a host to dynamically adjust its time. The host can have a better chance to collect more duplicate packets to avoid packet retransmission. This technique is reliable and allows the host to drop off a packet only when its neighbors can receive the same packet from other host.

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