Node Selection Based Broadcast in Manets to Improve the Efficiency

Anchal Garg, Mohit Garg
1 Department of Computer Application, SRM University, NCR Campus, Modinagar (Ghaziabad)
anchal@amtechnosoft.com
2 E Virtual Services, Noida
imsmohitmca@gmail.com

Abstract—In this paper, the issue of broadcasting in mobile ad hoc networks (MANETs) is considered. A node equipped with directional antenna can divide the Omni directional transmission range into several sectors and turn some of them “on” for transmission. In the proposed scheme using a directional antenna, forwarding nodes selected locally need to transmit broadcast messages, only to the restricted sectors, allowing for increased performance on transmit and receive and interference from unwanted sources. The directional antenna usage is combined with network coding based broadcasting. With the help of network coding each forwarding node combine some of the messages it receives before transmission thereby reducing the number of transmissions each forwarding node performs in the message broadcast application.

Keywords: Broadcasting, Directional antenna, Network Coding, Adhoc networks.

I. INTRODUCTION

Mobile Adhoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration. The routers are free to move randomly and organize themselves arbitrarily; the network’s wireless topology may change rapidly and unpredictably. Ad hoc networks are suited for use in situations where an infrastructure is unavailable or to deploy one is not cost-effective. One of many possible uses of mobile ad hoc networks is in some business environments, where the need for collaborative computing might be more important outside the office environment than inside, such as in a business meeting outside the office to brief clients on a given assignment. Mobile ad hoc networks pose several technical and research challenges that need to be addressed. Ad hoc architecture has many benefits, such as self-reconfiguration and adaptability to highly variable mobile characteristics such as power and transmission conditions, traffic distributions, and load balancing.

Broadcasting is the most frequently used operation in mobile ad hoc networks (MANETs) for the dissemination of data and control messages in many applications. Usually, a network backbone is constructed for efficient broadcasting to avoid the broadcast storm problem caused by simple blind flooding, where only selected nodes that form the virtual backbone, called forwarding nodes, forward data to the entire network. In MANETs, the forwarding node set for broadcasting is usually selected in a localized manner, where each node determines its own status of forwarding or non forwarding based on local information or the status of a node is designated by its neighbours.

A smaller-sized forwarding node set is considered to be more efficient due to the reduced number of transmissions in the network, which helps to alleviate interference and also conserve energy. Therefore, by reducing the total number of transmission sectors of the forwarding nodes in the network, the interference can be alleviated, as well as the energy consumption.

In this paper, we try to combine the advantages of both network coding and directional antennas to achieve efficiency in broadcasting. We analyze the performance of these two methods and design an algorithm—Efficient Broadcast using Network Coding and Directional Antennas (EBCD).

II. RELATED WORKS AND PRELIMINARIES

A. Broadcast in Manets

Both probabilistic and deterministic approaches have been proposed for efficient broadcasting. Probabilistic approaches use limited neighbourhood information (local information) and require relatively high broadcast redundancy to maintain an acceptable delivery ratio. Deterministic approaches select a few forwarding nodes to achieve full delivery. Most of these approaches are localized, where each node determines its status based on its h-hop neighbourhood information. The decision of forwarding nodes can be made under both static and dynamic local views.

B. Network Coding

Network coding can be used to allow the intermediate nodes to combine packets before forwarding. Therefore, network coding can be used for efficient broadcasting by reducing the total number of transmissions. A proactive compensation packet constructed from un forwarded messages is periodically broadcast using network coding to improve the delivery ratio of the
probabilistic broadcast approach. The Reed-Solomon code was exploited to design an optimal Reed-Solomon code-based algorithm. Network coding can also be used in other applications, such as security services in wireless sensor networks peer-to-peer and the MAC layer protocol.

C. Directional Antennas

Two techniques are used in smart antenna systems that form directional transmission/reception beams: switched beam and steerable beam. The most popular directional antenna model is ideally sectorized, where the effective transmission range of each node is equally divided into K non-overlapping sectors, where one or more such sectors can be switched on for transmission or reception. The channel capacity when using directional antennas can be improved and the interference can be reduced. Steerable beam systems can adjust the bearing and width of a beam to transmit to, or receive from, certain neighbours. The corresponding antenna mode is an adjustable cone. In practical systems, antenna beams have irregular shapes due to the existence of side lobes, which may cause inaccurate estimations. DCDS extended the CDS approach for broadcasting with the help of directional antennas. The minimum DCDS problem is proven to be NP-complete. Using DCDS, not only forwarding nodes, but also forwarding edges of each forwarding node, are designated. All of the above schemes assume an Omni directional reception mode.

III. Broadcasting with Network Coding and Directional Antennas

In this section, we first extend the approach to construct the DCDS (Dynamic Directional Connected Dominating Set) to a dynamic version. The DCDS is proposed for the construction of a directional network backbone, where each node determines locally not only its status of forwarding or non-forwarding nodes but also its forwarding edges if it is a forwarding node. Then, in a broadcast initiated from any source node, the source uses directional transmission if it detects a forwarding node in that direction, to send the message. Then, forwarding nodes forward the message toward only their corresponding forwarding edges and the entire network receives the message. The DCDS is a directional network backbone assuming that K is infinite and each outgoing edge is a transmission sector.

We then combine the network coding with the dynamic DCDS to develop an algorithm.

Before broadcast begins
1. Exchange “Hello” messages to update local topology.
2. Update neighbourhood node priorities based on each received message.
3. When the timer expires, apply dynamic node/edge coverage conditions for each message.

4. If v is a forwarding node for some messages, (1) align the edge of a sector to each forwarding edge, (2) determine coded messages in each sector using coding, (3) select the position with the fewest total transmissions.
5. Forward coded messages in each selected sector.

IV. Implementation Issues

In this section, we discuss some implementation techniques of the above proposed approach.

The unidirectional transmission range of each node is divided into K sectors and each forwarding node only needs to switch on several sectors for transmission while the entire network receives the broadcast message.

A. Neighbourhood and Piggybacked Information Collection

Note that no GPS assistance is necessary in the proposed algorithm. In the algorithm, each node sends out “Hello” messages K times in all K directions and accomplishes the directional neighbourhood discovery. In this case, after h rounds of the message exchange, each node knows its h-hop neighbourhood information, which includes both neighbours and the locations of the sectors, where these neighbours are located. According to this information, each node can create the neighbour reception table. After a node determines its status together with the forwarding edges, it piggybacks this information in the broadcast message as part of the q most recently visited node information.

B. Message Encoding

In step 4 of the algorithm, after the positions of the K sectors are determined, the forwarding node can construct K neighbour reception tables and except that the neighbours in each table are only the neighbours who reside in the corresponding sector of the forwarding node. Then the forwarding node can apply any message encoding methods to determine the messages, original or coded, that need to be transmitted for each sector; such methods include the XOR based algorithm.

C. Mobility Handling

The proposed approach aims at reducing redundancy in the broadcasting procedure via restricting transmission directions and merging transmitted packages. Hence, energy consumption, as well as signal interference, can be decreased. However, when node movement is introduced in the network, the delivery ratio of the proposed approach will be smaller than that of regular broadcast approaches without directional antennas or coding. The detailed comparison is shown in the next section. One solution is to introduce a controlled
transmission redundancy to improve the delivery ratio in the existence of node mobility. The energy efficiency and delivery ratio is a trade-off. Note that this scheme efficiently improves the delivery ratio since no ACK/NACK information exchange is needed.

V. CONCLUSION

Network coding has been exploited for efficient broadcasting to reduce the number of transmissions in the multiple source broadcast application. We combine the network coding-based broadcast approach with broadcasting using directional antennas for a more efficient broadcast strategy, and develop efficient broadcasting using network coding and directional antenna algorithm (EBCD). We extend existing broadcasting using the directional antenna approach to a dynamic mode. The proposed approach has better performance than traditional CDS-based broadcasting and the existing network coding-based broadcasting in terms of energy consumption. In a dynamic environment with signal interference and node mobility, it has better performance against collision, but worse performance when it comes to movement. In the future, we will improve the robustness of mobility for the proposed approaches.

REFERENCES


