Efficient Cooperative Routing in MANET using Combining Techniques with AAF and DAF

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Abstract - Mobile Ad-Hoc Network is most prominent area of research for sharing information efficiently and properly among mobile devices over wireless channel. In this paper a cooperative routing methodology is proposed which utilizes the cooperative network with relay. This system is designed to communicate in dual hop mode and the transmission is completed with two modes one is detect and forward and another amplify and forward, and at the receiver side the combining techniques (ERC, MRC and SC) are used to reduce the effect of errors. Performance of the system is calculated as bit error rate (BER) which is shown in simulation results.

Keywords - BER, MANET, Cooperative Routing, Dual-Hop, EGC, MRC and SD.

I. INTRODUCTION

Over the last two decades, telecommunication networks have seen an explosive growth, mainly due to the rapid advancements in wireless communications. A plethora of wireless technologies have emerged, including Wireless-Fidelity (WiFi), Bluetooth, ZigBee, Ultra Wide Band (UWB), Worldwide Interoperability for Microwave Access (WiMax), etc. These technologies are being supported by an ever increasing number of devices for example laptops, tablets, smart phone, etc., allowing them to connect to a range of networks. In general, wireless networks can be broadly categorized into infrastructure-based networks and infrastructure-less networks. Such as infrastructure-based networks include Global System for Mobile Communications (GSM), Universal Mobile Telecommunications System (UMTS), Long Term Evolution (LTE) and Wireless Local Area Networks (WLANs). All these standards are based on a fixed, wired, backbone infrastructure. Through this backbone (back up) network, the data traffic is routed on the internet. Contrary to this, infrastructure-less networks do not rely on such a wired backbone and are created when wireless devices communicate directly with another, during point-to-point connections.

For example, mobile ad hoc networks (MANETs) are decentralized wireless networks that do not rely on a pre-existing infrastructure. The independence from a pre-established infrastructure is achieved by increasing the node functionality. For example, a node in a MANET directly forwards the data to the other nodes, thus eradicating the need for routers or access points. Compared to infrastructure-based networks, some of the advantages of MANETs include independence from central network administration, the scalability, rapid deployment, cheaper network and setup last mile connectivity. There is some of the major utilization envisioned for MANETs include military applications disaster management, and extended network connectivity. Mobile ad hoc networks (MANETs) are a class of Mobile networks that do not rely on a pre-existing infrastructure. Because of the infrastructure-less nature of MANETs, the nodes themselves act as routers. A Wireless mesh network (WMN) is a special type of MANET that consists of a network of access points which are connected to each other through Mobile links. Fig. 1.1 shows the mobile terminals communicate with each other over the wireless channel. That network can be used in battlefields or in a disaster-hit area. Fig. 1.2 illustrates an example of a WMN where the static access points act as wireless routers while the mobile nodes are the mesh clients. Such networks can be used to implement a rooftop network which provides last mile connectivity to the residents in a neighborhood.

As the data rate requirements increase, the range of wireless network coverage has been reduced, raising investment expenses for building infrastructure with access points to cover service areas. WMNs are unique enablers that can reduce this cost due to their flexible architecture. Finally, Fig. 1.3 depicts an example of a WSN that collects the environment data and sends it to a central server.

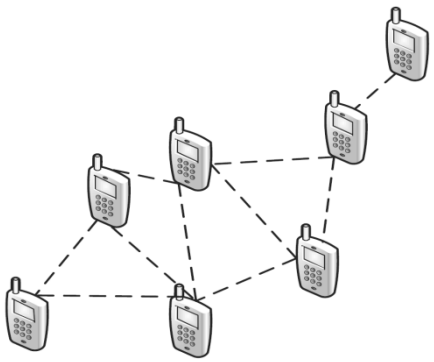

Fig. 1.1 A mobile ad hoc network formed of seven mobile terminals

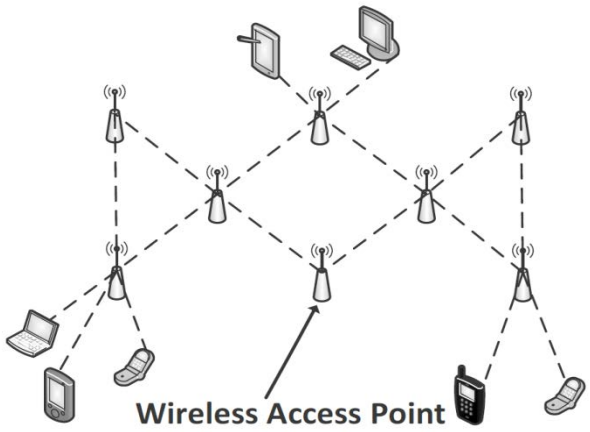

Fig. 1.2 A wireless mesh network of access points

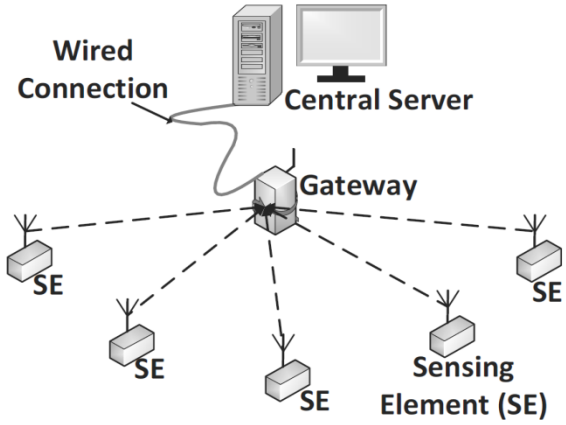

Fig. 1.3 A wireless sensor network

II. COOPERATIVE ROUTING

Energy saving is one of the main objectives of routing algorithms for different wireless networks such as mobile ad hoc networks [43] and sensor networks [44]. In [45], it was shown that in some wireless networks such as ad hoc networks, nodes spend most of their power in communication, either sending their own data or relaying other nodes' data. In addition to saving more energy, selected routes may guarantee certain Quality of Service (QoS). QoS routing is of great importance to some wireless applications (e.g. multimedia applications) [46].

The cooperative communication for wireless networks has gained much interest due to its ability to mitigate fading through achieving spatial diversity, while offering flexibility in addition to traditional Multiple-Input Multiple-Output (MIMO) communication. Routing algorithms, which are based on the cooperative communications, are known in the literature as cooperative routing algorithms [47]. Designing cooperative routing algorithms is an interesting research area and can lead to significant power savings. The cooperative routing makes use of two facts: the Wireless Broadcast Advantage (WBA) in the broadcast mode and the Wireless Cooperative Advantage (WCA) in the cooperative mode. In the broadcast mode each node sends its data to more than a node, while in the cooperative mode numerous nodes send the same data to the same destination. Most of the existing cooperation-based routing algorithms are implemented by finding a shortest-path route first and then building the cooperative route based on the shortest-path one. Indeed, these routing algorithms do not fully exploit the merits of cooperative communications at the physical layer, since the optimal cooperative route might be completely different from the shortest-path route.

In addition, most of these cooperation-based routing algorithms require a central node, which has global information about all the nodes in the network, in order to calculate the best route given a certain source-destination pair. Having such a central node may not be possible in some wireless networks. Particularly, in infrastructure less networks (e.g. ad hoc networks), routes should be constructed in a distributed method, i.e., every node is responsible for choosing the next node towards the destination. These are our major motivations to propose a distributed cooperation-based routing algorithm that takes into consideration cooperative communications while constructing the minimum-power route.

III. PROPOSED METHODOLOGY

The mobile ad hoc network is needed to be properly routed for sharing data among different nodes of the network. The routing methodology decides the delivery of packets/information from one node to another node.

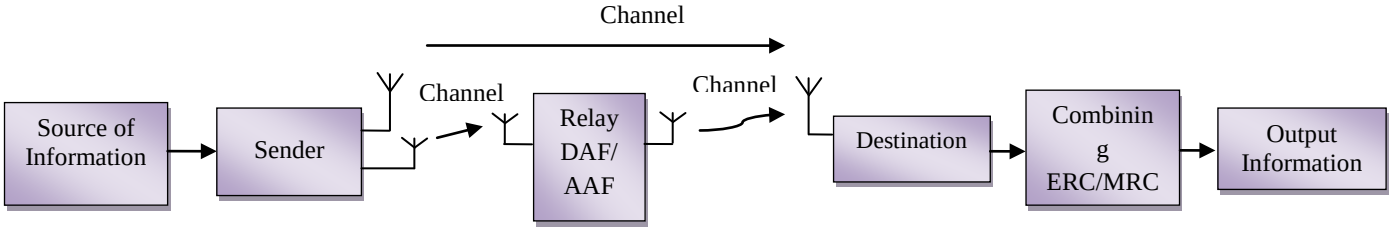

Fig. 3.1 Block Diagram of Proposed Methodology

Here a novel routing is proposed in which the dual hop cooperative technique is used to route packets. The dual hop network is network with at least one relay between source and destination. And after reception of packets on destination nodes there is combining technique which helps to recover error free information.

In this section the proposed cooperative routing methodology with dual hop system and combining technique is discussed for mobile ad hoc network (MANET).

The basic block diagram of proposed methodology have been explained here in this in a very first block the information is generated and by sender it is transmitted through a channel then Relay DAF/AAF is employed and at the receiver side the ERC, MRC and SD combining techniques are used then after the outcome have been analysed.

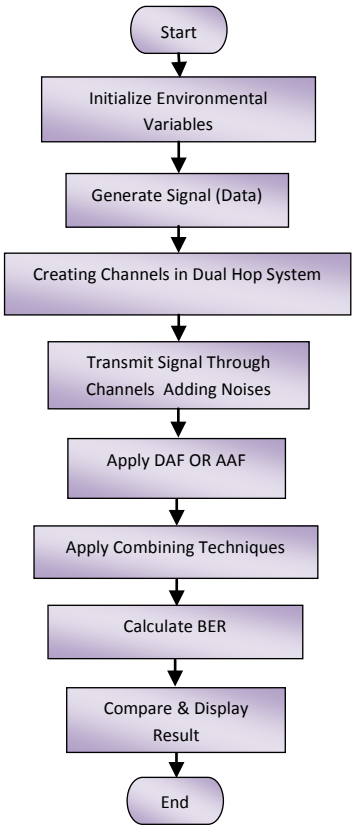

Fig. 3.2 Flow Graph of Proposed Methodology

The given flow chart shows the simulation process in that firstly the environmental variables are initialized then the signal is generated then after Dual Hop Channel is generated and then the signal is transmitted through noisy channel after this DAF and AAF are implemented then the combining technique is adopted at the end the calculation of BER and comparison the results have been analysed.

IV. Simulation Results

The cooperative routing with dual hop system is implemented using relay. For enhancement of the routing performance combining techniques are implemented and these are equal ratio combining (ERC), maximal ratio combining (MRC) and source to destination (SD) with two different modes detect and forward (DAF) and amplify and forward (AAF). And From the simulation results we can see that which technique is best.

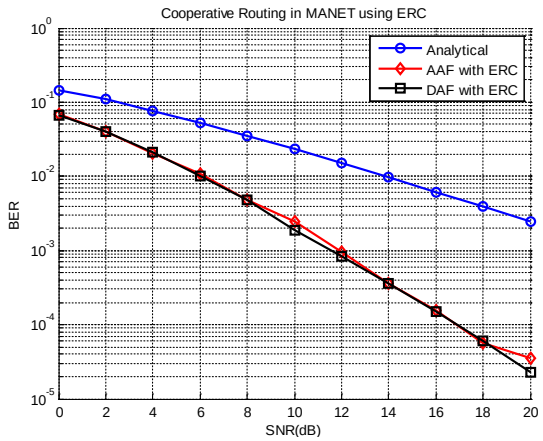

Fig. 4.1 BER performance of Cooperative Routing in MANET using ERC with AAF and DAF

In Fig. 4.1 MANET with dual hop cooperative routing is implemented is using equal ratio combining (ERC) is used with detect and forward (DAF) and amplify and forward (AAF) and the performance of the routing with DAF is little bit better with ERC.

In Fig. 4.2 Mobile Ad hoc Network(MANET) with dual hop cooperative routing is implemented is using maximal ratio combining (MRC) is used with detect and forward (DAF) and amplify and forward (AAF) and the performance of the routing with DAF is little bit better with MRC.

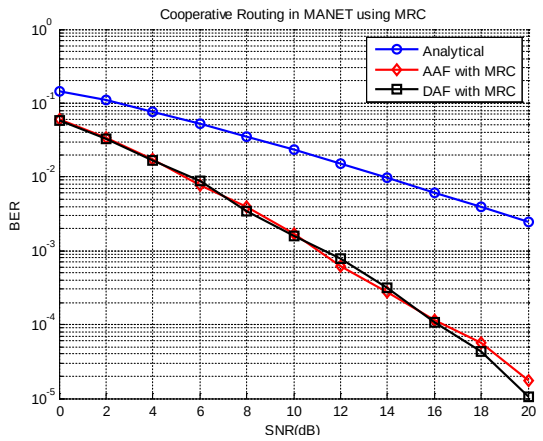

Fig. 4.2 BER performance of Cooperative Routing in MANET using MRC with AAF and DAF

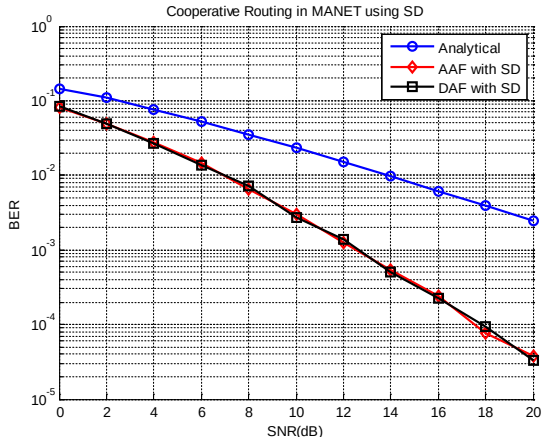

Fig. 4.3 BER performance of Cooperative Routing in MANET using SD with AAF and DAF

In Fig. 4.3 Mobile Ad hoc Network(MANET) with dual hop cooperative routing is implemented is using source to destination (SD) is used with detect and forward (DAF) and amplify and forward (AAF) and the performance of the routing with DAF is little bit better with SD.

Now if we compare all three methods we can see that with MRC MANET cooperative routing perform better than others, so that for optimum results we should use MRC.

V. Conclusion and Future Scope

As we have seen the previous section is that the performance of the mobile ad hoc network using cooperative routing with dual hop relay implementation is better when it is operated with detect and forward(DAF) or amplify and forward(AAF). Now other techniques also enhances the performance of the system as we have used in it equal ratio combining(ERC), maximal ratio combining(MRC) and source to destination(SD) is used with the above mentioned system, and among them MRC outperform.

With the advancement of combining techniques and use of efficient relay will make system more robust and improved. Somewhere the more complex modulation techniques also help to make routing better in mobile ad hoc networks.

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Kritika Kashyap is research scholar at Oriental Institute of Science and Technology, under Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal. She is pursuing her master of technology(M. Tech.) in Computer Science and Engineering. She is interested in doing research on mobile ad hoc networks for efficient routing methodologies on physical layer, and increase the performance of the system.