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RELAYING WITH LOCATION BASED REPEATED DOUBLE AUCTION FOR COOPERATIVE NETWORK

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ABSTRACT

Cooperative communication is an active area of research, and wireless devices are evolving into multipurpose systems with data extensive applications running on them, by this such applications require strong error protection and high speed connectivity. These networks are emerging to support the varied networks for an effective communication between the end users. The overall network performance depends on the optimal choice for relay nodes. In this paper, a relinquish mechanism based on locations with repeated selection technique is proposed for efficient the relaying. Nodes are made to be grouped. This plays a significant role for the usage of location based algorithm. Simulation is done by using NS2 and Simulation results shows that this relinquishing mechanism works seamlessly enhancing the overall performance of the wireless cooperative network.

Keywords: cooperative network, grouping, repeated double auction.

1. INTRODUCTION

Wireless networks such as adhoc networks, mesh networks, sensor networks have gained tremendous attention in the recent research works due to their application in both military and civilian domains. Cooperative communication is a means to enhance the performance of the system with spatial diversity. And MANET makes use of the changing topologies and the non-centralized nature of the cooperative transmission. Cooperative communications and networking provides new paradigms for distributed processing and transmission.

The basic block of the cooperative network is the relay channel. Finding the optimal relay allocation in cooperative diversity is very challenging. In a cooperative environment the system exchange cache data, reused by different parts of network enhancing the overall performance with reduced latency. Cooperation is also used to improve the data relinquishing in a system architecture incorporated with different networking technologies.

Cooperative communication refers to the collaborative processing and retransmission of the overheard information at those stations surrounding the source. Each node in a cooperative communication transmits data of their own and acts a cooperative agent for other nodes. Since nodes require their own energy to be used for the transmission, they might be reluctant to act as a relay node. Auction mechanisms have proven to be successful for the allocation of relay nodes in a cooperative environment [4,5,7,8].

Managing data routes in the whole network is a problem to be solved with cooperative methods. Location information is a requirement in many sensor network applications like tracking of mobile vehicles or animals, monitoring of elderly and disabled people in residencies, support for navigation, logistics and inventory management, and so on. In these cases, localization can be seen as a service in which some nodes provide location information and others require this service to determine their locations in order to perform location-aware functions. And this location based routing is proving to be successful in the field of wireless sensor networks when combined with grouping of nodes.

The main contribution of this study is as follows: We propose an auction mechanism for the relay nodes with two phases. This auction is said to take place based on the location information of the nodes. For the optimal functioning of this auction based relinquishing service, the nodes of similar characteristics are said to be grouped.

The remainder of this paper is organized as follows: The summary of the literatures on the relay assignment is provided in section II. We then introduce the network model, group formation and location based routing in section III. In section IV we devise the two phase auction for relaying with location. The implementation work with performance analysis and the conclusion are shown in section V and section VI respectively.

2. RELATED WORK

Yang *et al.* [1] studies the relay assignment problem in cooperative networks, is reduced to the Maximum Weighted Bipartite Matching (MWBM) problem. A polynomial time algorithm to optimally solve the relay assignment problem has been designed. The algorithm works for all the CC modes used in the network. Relay nodes are usually reluctant to relay data for other nodes, since they need to consume their own energy and other resources. Shastry *et al.* [2] addresses the issue of stimulating cooperative diversity, using the amplify-and-forward protocol, among selfish nodes in wireless adhoc networks. A pricing game that stimulates cooperation via reimbursements to the relay is used. This pricing game is shown to converge to Nash equilibrium where cooperative

diversity is induced at intuitively reasonable network geometries.

Wang *et al.* [3] devises a two-level Stackelberg game to jointly consider the benefits of source nodes and relay nodes in cooperative communications. The game is divided into two levels of hierarchy: the source node plays the buyer level game and the relay nodes play the seller-level game

A compensation framework such that the relay has incentives to forward the users' signals has been proposed by Ren *et al.* [4] . Specifically, depending on the quality of the received signals, the relay sets the prices to maximize its revenue and correspondingly charges the users utilizing the relay for their transmissions. Given the specified price, the users competitively employ the relay node to forward their signals

Huang *et al.* [6] investigated the relay assignment problem by incorporating fairness and energy efficiency. He proposes two auction mechanisms, the SNR auction and the power auction, that determines relay selection and relay power allocation in a distributed fashion. The work focus on answering the following two questions: 1) "When to relay", and 2) "How to relay". These two issues are addressed by designing an auction-based resource allocation framework.

Auction theory is applied by Yang *et al.* [7] to cooperative communications to either efficiently allocate resources or incentivize wireless devices to participate in cooperative communications. Yang et al. propose a VCG-based auction mechanism, which can maximize the revenue while enforcing the truthfulness. To overcome the high time complexity of the VCG-based auction mechanism, another truthful auction mechanism with low time complexity is designed.

Sushant *et al.* [9] discusses on network optimization problem that requires joint optimization of session grouping, relay node grouping, and matching of session/relay groups. A polynomial time algorithm to this problem is also presented. In a multi-session network, it may not be desirable to put all the sessions in one group and all the relay nodes in another group. It is seen that it might be more appropriate to put sessions and relay nodes into different groups and match them up appropriately for optimal performance.

3. SYSTEM MODEL AND GROUPING

A multi hop wireless sensor network consisting of M groups is considered and is shown in Figure-1. Group i has n_i nodes with a Group Agent to manage the group for the auction mechanism , a relay node for relinquishing and one of the nodes acting as the relay destination enhancing the cooperation within the group,(where i=1,2,…M).

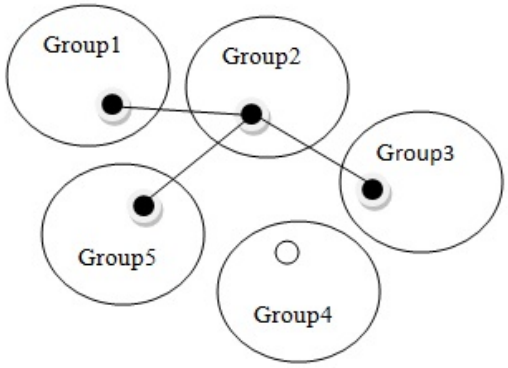

Figure-1.

Here, we consider the wireless networks with nodes which could vary its transmitting range to communicate with any nodes in the network. In this environment when the grouping is done many connections could be multiplexed into few paths. This reduces the overall interferences with well controlled manner.

The Group Agent construction is comprised of two stages:

a) Grouping stage

The randomly deployed nodes in the wireless sensor network are partitioned into groups based on some distributed clustering algorithm [10].

b) Choosing stage

The node could be selected as a Group Agent on varying characteristics like remaining energy , nodes ID, Voting , probability function and the like being used in the cluster head selection in the clusters.

The issues of group formation and Group Agent selection is beyond the scope of this paper. We focus only on modeling the traffic along the multi hop relay nodes of the cooperative network.

The information residing at a source node in some network may be required by some other nodes which act as requesting nodes in other networks. The request message and the data are said to be transmitted through the elected relay nodes of various groups. On receiving the data at the relay node of the groups where the request are said to be originated, the data is said to be forwarded to the request nodes as well as a node which serves as relay destination within that group enhancing the reliability within the groups. This relay destination could be the Group Agent or any other node other than the relay node.

4. LOCATION BASED REPEATED DOUBLE AUCTION AND ROUTING

a) Location based repeated double auction

The nodes in the group submit its bid for other nodes within that group to act as relay node to the Group Agent. The nodes which are willing to act as the relay node submits its ask to the Group Agent [11]. Both this bid and ask depends on the position of the nodes. The

node with the location whose sensing range includes many other groups and maximum number of nodes in other group is usually opted for the relaying service. The Group Agent then forwards this auction data to their auctioneer. This auctioneer does the recalculation for bids and asks based on its pervious history and elects the relay node. The auctioneer replies the Group Agent about the relay allocation from where the other nodes are relieved about the result.

b) Relay nodes routing

The relay nodes opted will be in the communication range of all other nodes in the group and could communicate with all other neighboring relay nodes. The requests for the source data is relinquished to the relay nodes of its neighboring group. This request is multi hopped to the relay nodes of various group until where the source node resides. On obtaining the source data by the relay node of the source group the data is relinquished with reversal request path.

5. IMPLEMENTATION AND PERFORMANCE ANALYSIS

a) Implementation

The environment required for the system formed with grouping is shown in Figure-2. Nodes of twenty six numbers are used which are partitioned into five groups with five nodes in four groups and six nodes in one group. Nodes 4,16,17,21 and 24 are fixed as Group agents for each group. There are four auctioneers involved in the network. With Location Based Repeated Double Auction, involving the group agents and the auctioneers nodes 8.,9,12,13 and 18 are selected as the relay nodes for the partitioned five groups.

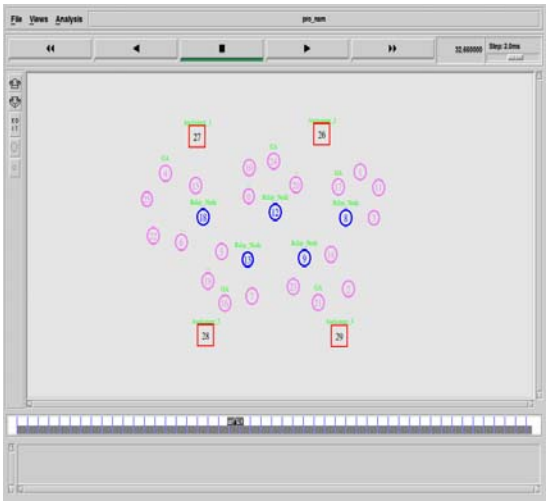

Figure-2.

b) Performance evaluation

In Figure-3, the comparison of the proposed Location Based Repeated Double Auction (RDA-LB) and the existing Repeated Double Auction (RDA) with the packet losses Vs time shows the better result for the proposed RDA-LB.

Similarly, in Figure-4 the number of packets delivered Vs the time is higher for the proposed location based system than with the existing system.

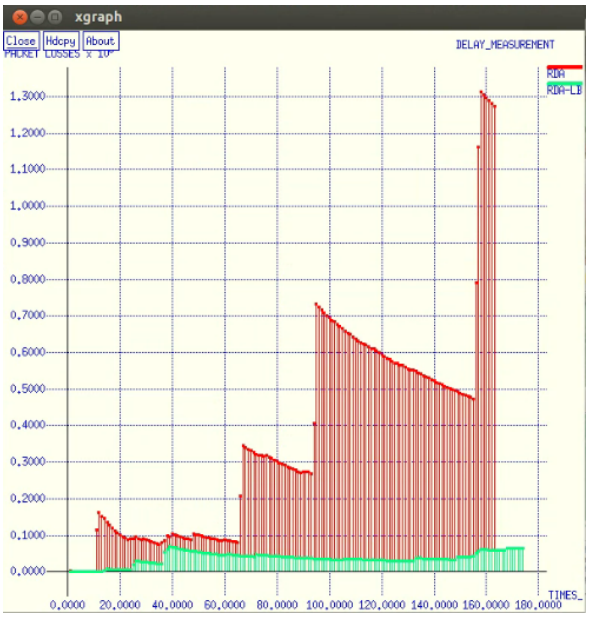

Figure-3.

Figure-4.

Figure-5 shows the channel measurement for the proposed RDA-LB system to be efficient when compared with the existing Repeated Double Auction.

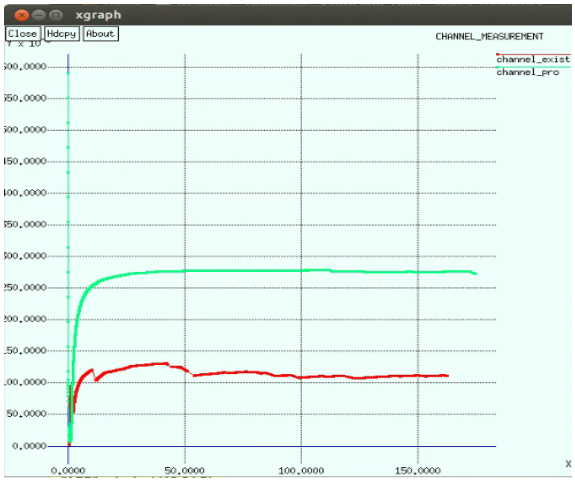

Figure-5.

With the graph shown in fig 6, for the signal strength of the source nodes with respect to time ,it is seen that the nodes in the proposed location based RDA system to have good signal frequency compared with exixting RDA.

Figure-6.

6. CONCLUSIONS

In this paper, the relay assignment problem for the cooperative networks has been studied. We then propose an auction mechanism based on the location of the nodes for the optimal relay allocations. This assignment is said to be carried with two phases. We conducted experiments by simulation showing the results of the proposed Location Based Repeated Double Auction (RDA-LB),to be efficient compared to the exixsting auction mechanisms, enhancing the overall system performance.

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