International Journal of Advance Engineering and Research Development (IJAERD)
Volume 1,Issue 7,July 2014, e-ISSN: 2348 - 4470 , print-ISSN:2348-6406

DEVELOPMENT OF RELAY SELECTION SCHEME FOR WIRELESS NETWORK

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Abstract: In wireless networks, Nodes are used as relays to forward information to the destination. It basically relies on the relay selection and power allocation process to optimize its performance because all available nodes are not beneficial to use for forwarding. In wireless channel, a transmission is overheard by adjacent nodes. A source in wireless network can use these adjacent nodes as relays and process and re-transmit the signals to the destination. Network performance can be enhanced in terms of energy consumption, reducing interference and increasing throughput.It also allows high-data-rate terminals to assist low-data-rate terminals by relaying their data to provide higher transmission data rates.In this paper, a new relay selection scheme for wireless mobile networks has been proposed that effectively distributes traffic of packets from source nodes to the sink based on the path rate between the source to relay and relay to destination. The source chooses the most optimal relay node to forward its messages by estimating the rate in two hops from source to relay and relay to destination. This relay selection scheme provides increased packet delivery ratio and less average energy consumption.

Keywords–Wireless mobile network,Throughput, Packet Delivery Ratio, Rate, Relay Selection.

I. INTRODUCTION

As the demand of wireless technology is growing regularly for the main medium of connectivity, demand for high data rate in wireless communication is also growing. This is because of increase in the number of wireless communication user as well as increase in information which has to be transmitted. Development in the wireless technology has been rapid but certain physical parameters like limited frequency band, battery life, and severe fading channel are still affecting the performance of the wireless communication technology.

Relay selection is very important and crucial in improving the performance of wireless cooperative networks. Relaying is an emerging and effective technology which can overcome the limitation of cell coverage and cell edge user's throughput and improve overall system performance of wireless networks [1].

Wireless sensor networks (WSNs) have become very attractive technology for industrial and factory automation, distributed control systems and automotive systems [2], [3].Various promising and interesting research areas in the design of protocols and systems for wireless industrial communications have been proposed. Various topics in the industrial communications like wireless sensor networks, IEEE 802.15.4, ZIGBEE, ANDISA SP-100, IEEE 802.11E and their related issues like Quality of service (QOS), architecture, scalability, energy efficiency have been discussed.Wireless communication offers many advantages compared to wire line systems by allowing mobility to users, but various factors

like path loss, thermal noise and timevarying affects it. It leads to the reductionof throughput in wireless networks. To overcome this problem, multiple-input multiple-output (MIMO) is a very promising technique that can be used to enhance the performance in WSNs, but devices in MIMO requiresseveral antennas. It is not feasible due to their size and weight limitations.

Nodes in wireless networks utilizes overheard transmission by adjacent nodes for relaying,processing and re-transmitting the signals to the destination. This technology significantly enhances the network performance in terms of saving power or energy [4], reducesinterference and increases throughput [5]. High-data-rate terminals can also help low-data-rate terminals by relaying their data [6].A wireless Ad Hoc network is a gathering of independent nodes, which are planned to communicate with one another by forming a multi hop radio network, also retains connectivity in the mode of decentralization. The ad hoc network contains nodes which uses wireless interface with an ability of forwarding data packets.Various routing protocols have been proposed for Ad hoc networks for efficient transmission. It can be categorized into two schemes, namely reactive and proactiverouting schemes.Selection of appropriate relay is most important in wireless mobile network tooptimize the performance of the network. Some relay selection schemes based on the rate, on the paths have been proposed previously [8], [9]. In previous works, it has been assumed that the rate is known, but it has not beendescribed how the source can get the rate information. In this paper, a new method based onthe rate computation has been proposed. In this method, source node takes advantage of advertising packet (ADV) that is periodically transmitted by all nodes in the network for the estimation of the hop rates of the nodes around it. Source node can determine the most optimized neighbor node to become its relay. Our scheme providesincreased packet delivery ratio and reduced energy consumption compared to direct transmission.

II. SYSTEM MODEL

A. Channel Model

Consider the network scenario,in which node i and node j are the two nodesin which transmission takes place and when node i transmits the data to node j, the received signal at the node j can be represented as:

$$y_j = h_{ij}\, x_i + n_{ij} \qquad (1)$$

Where, x_i is the signal sent by the source node and y_j is the signal received at the destination node. h_{ij} is the channel coefficient that represents the effectsof shadowing and fading between node i and node j.n_{ij} is the additive white Gaussian noise. Destination node calculates the rate of path between the nodes using following equation.

$$R_{ij} = W \log_2\left(1 + \frac{P\gamma_{ij}}{N_0\, d_{ij}^{\alpha}}\right) \qquad (2)$$

Where, W is the bandwidth, P is transmitter power, N_0 is AWGN, α is path-loss exponent, d_{ij} is the distance between the nodes and $\gamma_{ij} = |h_{ij}|^2$.

B. Ad hoc network model

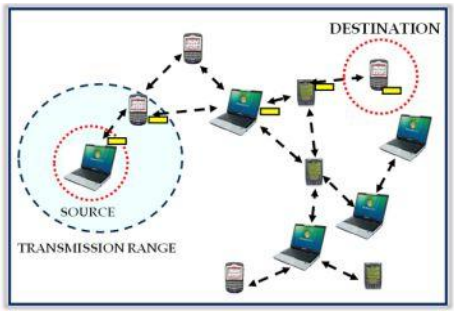

Fig.1: Typical ad hoc network Model

Fig. 1 represents a typical wireless network model, which includes onesource, various intermediate nodes and one destination, eachwithsingle antenna.

In the infrastructure-less mode, also called ad-hoc mode, there are no centralizing elements, nodes are typically mobile, and nodes work in a collaborative way for routing packets across multiple hops to the destination. In this network, nodes that are not within the direct transmission range of each other will require other nodes to forward data.The IEEE 802.11 standards are used for WLAN technology. It employs carrier sense multiple access with collision avoidance (CSMA/CA) as its medium access protocol for the distributed coordination function (DCF) mode. In this mode, each station can initiate a data transmission by itself. Channel sensing before packet transmission is essential to avoid collisions. If one station has data packet to send, it will first sense the channel to make sure thechannel is clear before the actual transmission starts. Collision may occur even if the channel is sensed to be free because all stations can not hear each other. Thus virtual carrier sensing is also employed with the use of the Request to Send (RTS) and Clear to Send (CTS) frames to reserve channel time for the transmitting stations. These two control frames broadcast the channel reservation information to the whole network. Any station will be able to hear at least one of these control packets and use them to calculate the time needed for the data packet transmission. A Network Allocation Vector (NAV) is used by all the stations to discover the time for which the channel is going to be free.

The operationofthe source,relay, anddestination nodes is describedas follow:

- SourcenodeS:Sourcenode broadcastsRTSpacketto nodesaroundit to transmit the message. When source node receives clearto send(CTS) packetsfrom the destination and relay, it sends datapacket.
- RelaynodeR: When relay nodereceives RTSfrom the source it looks for the destination, and if it knows the route, it forward the message to the destination, otherwise it rebroadcast the route request to neighbors node by recording the node from which first copy was received.
- Destinationnode D:Ifthe destinationreceives aRTSfrom the source, it then replies by sending backto thesourceand therelayCTSpacket.

C. Relay Selection

In order to model the relay selection algorithm, we investigate a communication system that includes one source, one destination and k candidates for the relay. In this case, the destination is not in the

transmission range of the source. This system uses proactive protocol so that the source always builds a table that includes the information about the rate of all possible candidates in the network.The algorithm for the relay selection is as follows.

D. Network Topology

In a network,whenasourcewantsto senddata to the sink, it always chooses the shortestwayto the sink to send data. To dothat, allnodesincluding sinkperiodicallybroadcast the advertisingpacket(ADV), which includes information about hop count, time of arriving (ToA), andrate ofpathsto allothernodes in the network.When the ADVarrivesin the source,the source is ableto know which waythat has the lowest hop countfrom it to the sink.

III. PROPSED ALGORITHM

At first, each node, including sinks, periodically broadcasts an ADVpacket to all neighborsafterapredefinedperiod of time. Basedon that process,eachnodemaintains a table of potentialdestinations that can be used as relay to transmit its data.In the Algorithm,the source node looks for the one hopneighbors in its transmission range.It computes the path rate to its next hop neighbours. It also calculates the time taken to send the packets to the neighbouring nodes. The path rate between the nodes gives the link quality. The sourcenode willchoose the destination as the node that has the smallest time of arrival.The node with least time of arrival provides the minimum delay and best link quality, and that node is selected as relay. This process continues till the route is established to the destination The Algorithm is as follows:

Step 1: Deploy Nodes.

Step 2: selection of source and destination pair.

Step 3: Compute path rate between nodes.

Step 4: Broadcast ADV Packets.

Step 5: Maintain table of neighbours for each node.

Step 6: Select the node with least TOA.

Step 7: Repeat step 6 till the destination is not found.

The flowchart of the algorithm is as follows:

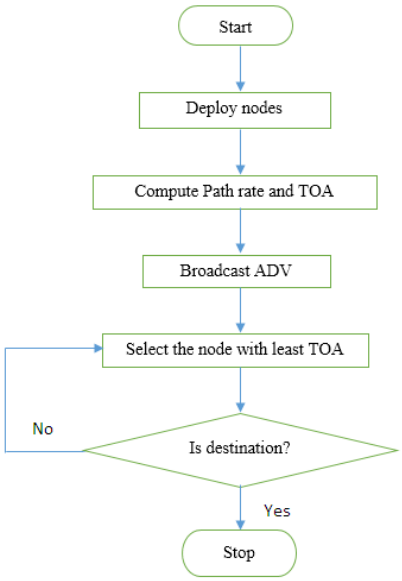

Figure 2:Flow Chart of the proposed algorithm.

IV. SIMULATION AND EVALUATION

A. Simulation

Theproposedschemes are simulated by Network simulator (NS2). The network includes 30 nodes, whichdistributesrandomly in a 1000mx700m area. The 802.11 MAC protocolis used in implementing the proposedscheme. Thedetailed simulationparametersare listed in Table I.

Table I
SIMULATION PARAMETERS

Parameters	Values
Chanel Type	Wireless Channel
Antenna Model	Omni Directional
Radio Propagation Model	Shadowing Model
Mac Layer Protocol	CSMA/CA for 802.11
Traffic Type	Constant bit rate (CBR)
Network Area	1000*700 m^2
NO. of nodes	30
Bandwidth	20 MHz
Path loss Exponent	2.7
Transmitter Power	0.175 mW

MAC Protocol	CSMA/CA for 802.11
Simulation time	50 s
Carrier frequency	2.4 GHz
Packet Size	500 bytes
Initial Energy	10 J

B. Numerical Results

Thesimulation obtained from theproposed rate aware relay selection scheme from sourceto relay results are subsequentlycompared with the exiting AODV routing protocol to show the effectiveness ofthe proposedschemein increasingpacketdeliveryratio and decreasingaverageenergyconsumption.

1) Packet delivery ratio: The performance of the proposed scheme and existing AODV protocol is evaluated in terms of packet delivery ratio. Packet delivery ratio is the ratio of packet received to the packet sent over a transmission. This ratio is calculated and compared at different node speeds. Proposed scheme provides better results compared to existing protocol. Figure 3 indicates that the proposed methodimproves the packet delivery ratio from average 92% to 98.5% compared to AODV routing protocol.Better packet delivery ratio results in better throughput. In the proposed scheme, source chooses the neighbor with least delay which results in good link quality and hence the packet losses are minimum and signal quality is good. Our proposed scheme improves thepacketdeliveryratio whencompared to AODV routing protocols in MANET.Shadowing model is considered for radio propagation model for better performance evaluation.

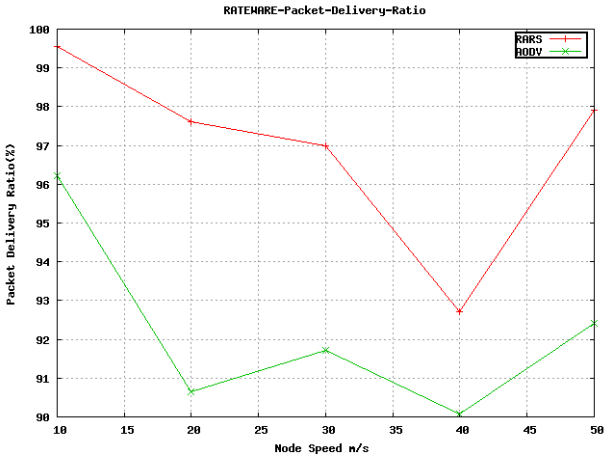

Figure 3: Packet delivery ratio

2) Average energyconsumption:

Figure 4 shows the energy remained in the network after the transmission of packets from the source to destination in the network. AODV protocol considers minimum hop count from source to destination. It results in more physical distance between hops and it requires more power to send the packet to next hop which consumes more energy. Proposed scheme selects the nearest node to source and it requires less

power to send the packet to next node. Hence RARS scheme consumes less power in transmission compared to existing AODV protocol. Power consumption is a crucial parameter in MANET because nodes are battery operated. Figure 4 shows the remaining energy at different node speeds for both cases. RARS scheme consumes less energy compared to Existing AODV protocol.

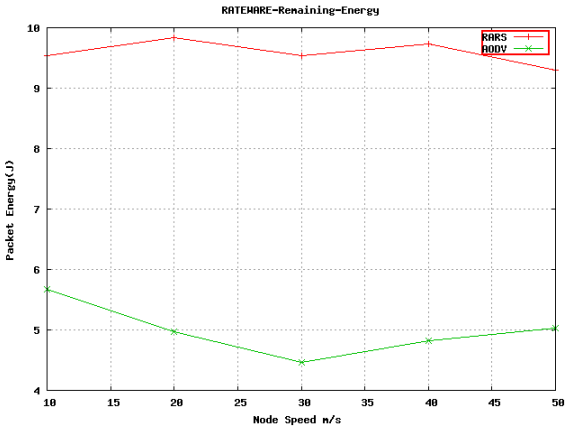

Figure 4: Average Energy Consumption

V. CONCLUSION

In this paper, are liable relay selection method have been proposed, where the source exploits the rate information of the paths from source to relay and relay to destination. Numerical and simulation results confirmed that the proposed scheme significantly outperforms the existing AODV routing protocol and provides better packet delivery ratio and consumes less energy during transmission. The radio propagation model is considered to be shadowing model. The proposed algorithms performance can be improved by modifying the algorithm to reduce the average end delay. The PDR of RARS algorithm is 98%. It can be further increased in future. Packet drops can be reduced using effective scheduling strategies. The beam forming scheme can be implemented to increase the capability. This algorithm can be effectively used in military applications which include establishing communication among a group of soldiers for tactical operations.

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