SINR and RSSI Based Optimized AODV Routing Protocol for MANET using Cross Layer Interaction

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Abstract: ***In this paper we define cross layer interaction system in which we have MAC level rate selection based signal-to-noise-plus-interference ratio (SNIR) and received signal strength indicator (RSSI) information from physical layer. Cross layer design involves the passing information between physical layer to MAC layer. We use a new metric definition to route the packet and to choose strongest path in multi routes and highest received signal strength. SINR is commonly used in wireless communication as a way to compute the quality of wireless connections and RSSI which determines the received signal strength in wireless environment .Simulation results optimized AODV protocol perform better than AODV protocol in terms of metrics: End to END delay, Packet delivery ratio, throughput.***

Keywords: MANET, RSSI, SINR, Optimized AODV, IEEE MAC802.11

1. Introduction

MANET is a set of wireless and mobile nodes that are able to communicate in absence of any pre-established communication infrastructure [1].An adhoc network is a local area network (LAN) that is built spontaneously as device connects. It is self creating, self organizing and self-administrating network. Each node acts as a host and router and forwards each other's packet to enable the communication between nodes [2].

The aim of Cross-layer perception is to improve the performance of all layers and share key information between these layers. Cross layer design is a rising proposal to support flexible layer approaches in Mobile Ad-hoc network (MANETs). In cross layer Communication systems that need to operate over media with non stationary background noise may benefit from having a close synchronization between the MAC layer (which is responsible for development transmissions) and the PHY layer (which manages actual transmission and reception of data over the media). Whole system performance can be improved if the MAC can get information from the PHY about when and how the noise level is changing, as a result the MAC can schedule transmission during the periods of time in which noise levels are lower [3].

2. Literature survey

There has been significant research on cross layer optimization in MANET. Energy –based routing optimization in MANET: cross layer benefits. Designed two energy-based mechanisms that are propose to overcome the issue of routing in MANETs. Result show that the performance of the layer cooperation paradigm depends on the network characteristics and the application constraints [4]

To overcome network performance problems, the Mobile Man cross-layer design lets protocols that belongs to different layers cooperate in sharing network status information while still maintaining the layers' separation at the design level in cross layering in mobile ad hoc network design [5].

The modified version of AODV routing protocol utilizing physical layer information i.e. SNR based AODV shows performance improvement of the proposed SNR-based AODV protocol in cross-layer optimization of AODV routing protocol for mobile ad-hoc network authors Mohammed kamrul Islam (ICCSEE2013)[6].

Adapting MAC 802.11 for performance optimization of MANET using cross layer Interaction is to reduce the false link failure in mobile ad hoc networks and thereby improve their performance. The MAC layer adaptively utilizes the physical layer information for differentiating false link failure from true link failure [7].Cross-layer Optimization of Multipoint Message Broadcast in MANETs in this worked adaptation of transmission rate and power to varying densities of ad-hoc nodes. Constructed cross layer model building on existing models for physical and link layer [8].

3. Problem Definition

In this paper we perform on AODV protocol based on a cross layer mechanism in which we use SNIR and RSSI information to better routing techniques. In SNIR we use multiple node we will select minimum packet energy value and forwarded to another node until it reach to the destinations. With the help of this we move towards weak link of the route which is calculated, after receiving Route Request by the destination node ,its send the Route Reply with minimum energy value of the route to source then source node first go for earliest established path to forward packets, then it will calculate maximum signal strength of each route from minimum energy value of route and choose maximum signal strength among the multiple routes, which we will convert into strongest signal Strength path for long transmission. We used RSSI for maintain every node in RSSI table. In SNIR we used RSSI for maintain relationship between transmitted power and received power of wireless signal and distance among the nodes. Strong signal without noise gives strong RSSI. Our objective is to remove overhead Routing, saving energy and strongest signal strength.

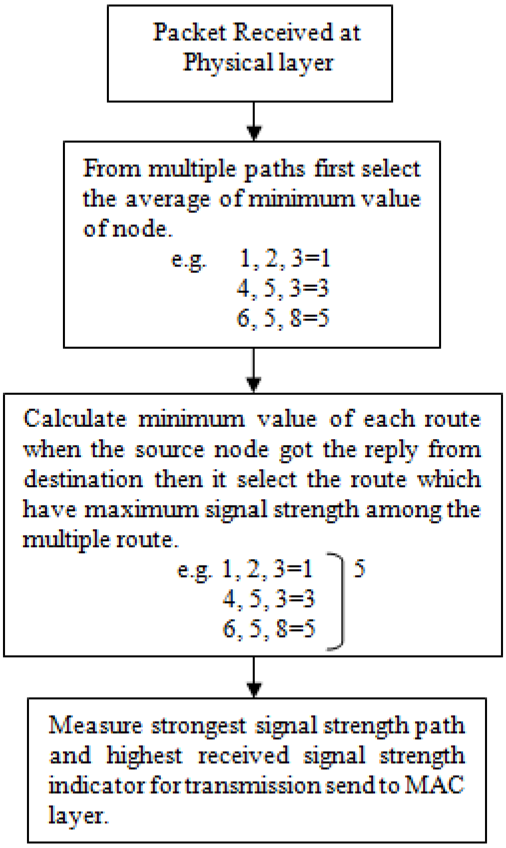

Figure1: Problem Definition Flow charts

3.1 SINR

SINR is commonly used in wireless communication as a way to compute the quality of wireless connections. Typically, the Power of a signal fades with distance, which is referred to as a path loss in wireless networks. Conversely, in wired networks the existence of a wired path between the sender or transmitter and the receiver determines the correct reception of data. In wireless network ones has to take other factors into account (e.g. the background noise, interfering strength of other simultaneous transmission). The concept of SINR attempts to produce a illustration of this portion.

$$\mathrm{SINR}(x)=\frac{P}{I+N} \quad (1)$$

Where P is the power of the incoming signal of interest, I is the interference power of the other (interfering) signals in the network, and N is some noise term, which may be a constant or random. [9]

3.2 IEEE 802.11 MAC Layer

In an IEEE 802.11 system, RSSI is the relative received signal strength in a wireless environment. Received Signal Strength Indicator in which the signal or circuit that indicates the strength of the incoming (received) signal in a receiver and measurement of the power present in a received radio signal. The 802.11 standard specifies a common medium access control (MAC) Layer, which provides a variety of functions that support the operation of 802.11-based wireless LANs. In general, the MAC Layer manages and maintains communications between 802.11 stations (radio network cards and access points) by coordinating access to a shared radio channel and utilizing protocols that enhance communications over a wireless medium. Often viewed as the "brains" of the network, the 802.11 MAC Layer uses an 802.11 Physical (PHY) Layer, such as 802.11b or 802.11a, to perform the tasks of carrier sensing, transmission, and receiving of 802.11 frames [10]. RTS/CTS are an additional method to implement virtual carrier sensing in Carrier sense multiple access with collision avoidance (CSMA/CA). By default, 802.11 rely on physical carrier sensing only which is known to suffer from the hidden node problem.RTS/CTS packet size threshold is 0–2347 octets. Typically, sending RTS/CTS frames does not occur unless the packet size exceeds this threshold. If the packet size that the node wants to transmit is larger than the threshold, the RTS/CTS handshake gets triggered. Otherwise, the data frame gets sent immediately.

IEEE 802.11 RTS/CTS mechanism could help solve exposed node problem as well, only if the nodes are synchronized and packet sizes and data rates are the same for both the transmitting nodes. When a node hears an RTS from a neighbouring node, but not the corresponding CTS, that node can deduce that it is an exposed node and is permitted to transmit to other neighbouring nodes. If the nodes are not synchronized (or if the packet sizes are different or the data rates are different) the problem may occur that the exposed node will not hear the CTS or the ACK during the transmission of data of its neighbour [11].

4. Approach

Our research applied to shared the information 'lower to upper layers' approach where information from physical layer to Mac layer. SNIR (signal-to noise-interference ratio) captures the interference effect from the environment and RSSI (Received signal strength indicator) which capture strongest signal strength.

4.1 Route Discovery

When the route is needed, the source sends the RREQ packet to his entire neighbor after that intermediate node does following steps:

First it checks the minimum to maximum strongest signal strength of the packet if it is greater than SIGNAL THRESHOLD value then it process the request otherwise it discard this RREQ packet then intermediate node checks its routing table for the desired destination. If it found then send a reply to the source otherwise it forwards the RREQ to his neighbor.

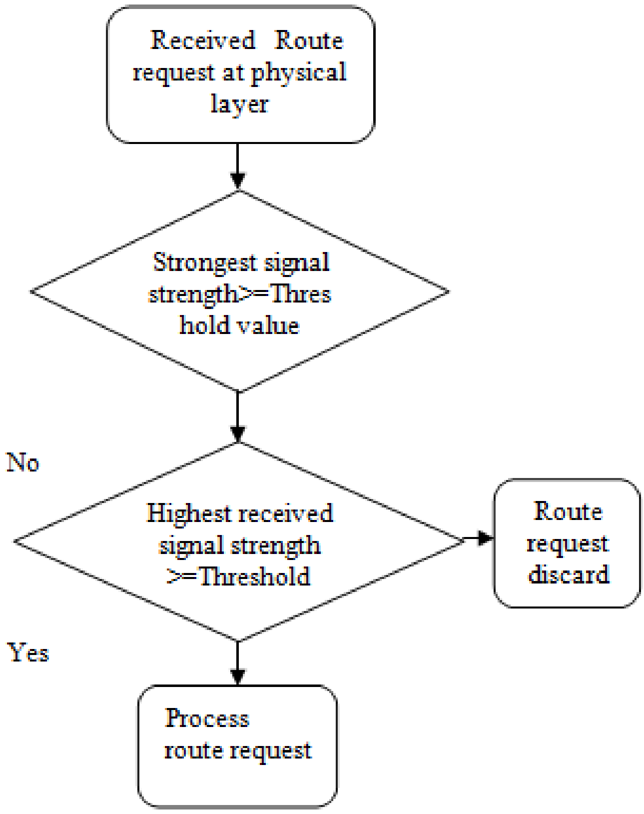

Figure 2: Route Discovery of Optimized AODV protocol

Each node maintains the RSSI table, RSSI table contain the signal strength value of node's neighbour, with the help of RSSI table node. Table contains three fields. Node ID: when a node receives a packet from a same neighbour node, it replaces the old entries of the table, corresponding to that node, with the more current one. RSSI neighbour node packet: The RSSI of neighbour node is tracked with the purpose of using it later for distinguishing if neighbour nodes are available or not i.e. the strong signal indicates that the neighbour node in transmission range and link will be available for longer time duration and the weak signal indicates that the neighbour node declining and link will be soon broken.

Timestamp: The timestamp of overhead packet can be used to sense the broken links due to mobility because due to mobility the receiver is not reachable and its packet has not been overhead since long time.

4.2 Calculation of RSSI

The principal of RSSI describes correlation between transmitted power and received power of wire-less signal and the distance among nodes. This relationship has shown by an equation (1).

$$Pr = Pt*(1/d)\ n \qquad (2)$$

Where Pr is receiving power, Pt is the transmitted power; d is the distance between sender and receiver node and n is the transmission factor whose value depends on the propagation environment. Take 10 times the logarithm of both sides on (2), and then Equation (2) is transformed to Equation (3).

$$10*\log Pr = 10*\log Pt - 10n*\log d \qquad (3)$$

Pr, the transmitted power of nodes, are given. 10logP is the expression of the power converted to dBm. Equation (3) can be directly written as Equation (4).

$$Pr\ (dBm) = A - 10*\log d \qquad (4)$$

A, is received power from references distance which is 1 meter. By Equation (3), we can see that the values of parameter A and parameter n determine the correlation between the strength of received signals and the distance of signal transmission [12].

5. Result and Discussion

We simulated Optimized AODV (along with AODV) using NS2 Simulator. In this paper, we present the simulation results and compare Optimized AODV with AODV. In this situation we change the number of nodes.

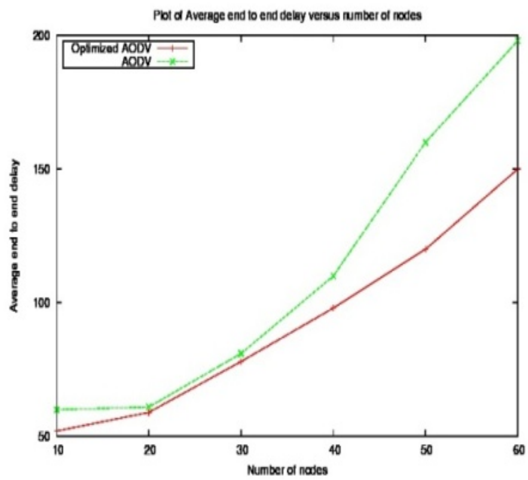

Figure 3: End to End Delay

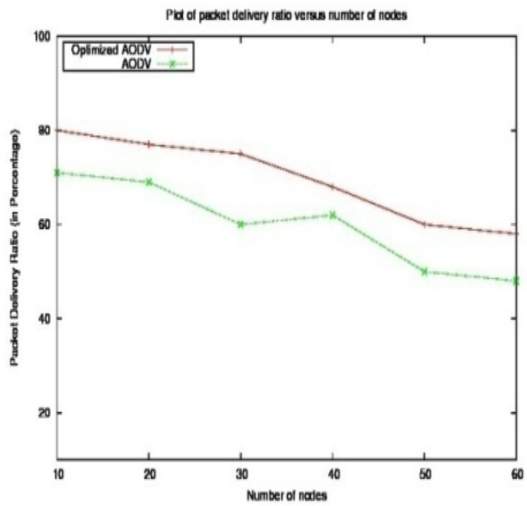

Figure 4: Packet Delivery vs. Number of nodes

Fig. 3 shows that as the number of node increases end to end delay in AODV increases rapidly as compared with Optimized AODV. Reason behind the reduction in end to end delay is because of the selective processing of signals. Weaker signals are discarded at the routing layer after comparing the RSSI with Signal threshold. This makes only selected signals entering into further processing phase thus reducing the end to end delay.

Fig. 4 shows that as the number of nodes increases routing overhead also increases, Optimized AODV avoid unreliable mobile nodes from the route, it requires less rerouting and leads to less control overhead so in large network Optimized AODV perform better than AODV. Fig. 5 Optimized AODV selects the most reliable path so number of packet loss is also low as compare to AODV. So the packet delivery ratio is also better than AODV in denser network.

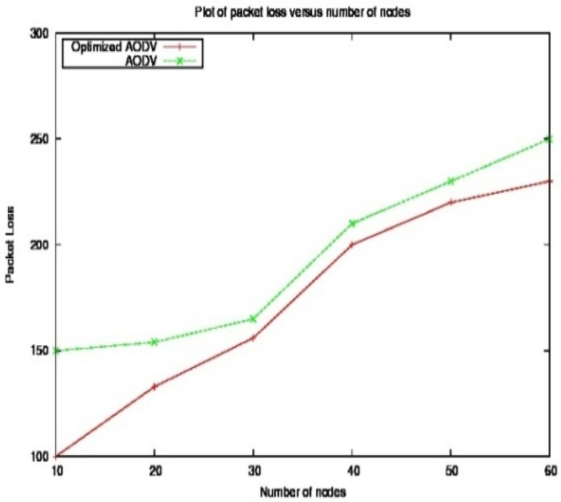

Figure 5: Packet Loss vs. Number of nodes

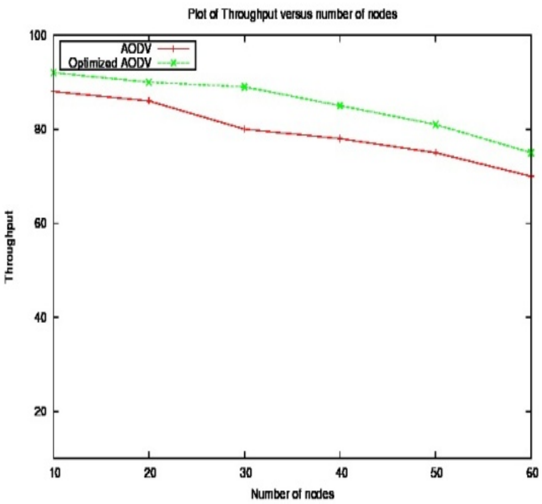

Figure 6: Throughputs vs. Number of Nodes

6. Conclusion

In this paper, we started to examine several cross-layer protocols and we have presented implementation of the AODV protocol which includes cross layer extension. The concept of cross-layer provides a wide field of information exchange between layers. In Optimized AODV protocol we used SNIR in the calculating of the network metric to choose the link with the strongest signal strength path and received signal strength indicator (RSSI) is a measurement of the power present in a received radio signal.

For Constant Bite Rate traffic, Optimized AODV is more advantageous at large network. As the number of nodes increases Optimized AODV take smaller end-to- end delay than AODV due to smaller retransmissions compare to AODV. Optimized AODV performs slightly better than AODV in most cases. Optimized AODV always seems to offer better performance in terms of Packet Delivery ratio and throughput when compared to AODV. Optimized AODV not only boost the network performance but also more reliable in data transmission as it reduces the network partition and packet loss in the networks.

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