Cyclic Sensing MAC Protocol for Multicast Routing in Mobile Ad-Hoc Networks

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Abstract:

In Ad Hoc networks realizing high throughput is achievable when directional antennas are utilized. The directional antennas lead to higher spatial multiplexing gain. On The Other Hand, there are a few issues in practice that comprise exposed terminal issues, deafness and hidden terminal causing the deterioration of the performance of the community. There are several MAC protocols which were proposed, the solution offered by Abdullah et al. is capable of solving the problems of open terminal, deafness and hidden terminal where a new MAC method is implemented using double sensing scheme. The Spintool is used for approval of the method integration. In this paper, we've nearly implemented the Macintosh protocol with directional antennas. The simulation results show the proposed MAC protocol is really capable of solving the issues of deafness, concealed terminal and exposed terminal issues. The outcomes are compared with a number of existing protocols.

Keywords: Directional antennas, ad hoc networks, dual sensing, simulation

I. INTRODUCTION

In Ad Hoc networks, it is really possible to realize higher throughput using directional antennas as they provide higher antenna gain. Additional benefits of the directional antennas include less use of transmission power, larger transmission range. Many realtime apps are derived from the directional antennas. For instance vehicular networks are normal example while the traffic runs in straight-line generally. Not only that, they are employed by Millimetre-wave communications to cure several path reduction problems. Higher spatial reuse is possible when directional antennas are utilized because they can lessen the blocked nodes in the system. But, MAC protocols that utilize directional antennas face challenges for example open terminal, hidden terminal and hearing loss. They change the functionality of the network badly. In the event of directional antennas, hidden terminals are found nearer towards the origin node and they are unable to hear transmissions of source node. For this reason- they may begin transmissions that will instance crashes. When a destination doesn't respond when it is receiving and sending in different direction, it is called deafness problem. While this isn't handled, it results in failed transmissions and considered by resource node as deafness. There's another problem here this is the source node could likewise look at the destination node as inaccessible.

In [1] a twin feeling directional MAC protocol is proposed that utilizes directional antennas to improve the delay performance and throughput in wireless networks. This is accomplished by reducing the undesired effect of hearing loss, exposed terminal and hidden terminal issues. In order to identify the deafness, the method makes use of busy tone signal coupled with the detection the action. This avoids the possible blocking problem. Asymmetry-in-gain is the other downside of present remedies which can be overcome in [1]. Afterwards, the proposed MAC protocol's strength is verified using Spin that is nothing but a protocol verification method. The simulator results reveal that the correctness of the proposed system is more in an order of magnitude. This document offers the simulated results-which demonstrate the efficacy of the suggested protocol.

The remainder of the document is structured into some sections. Section II reviews the function which has been done in materials. Part III supplies the projected design and its advantages. While the

section V concludes this document Experimental results are presented by the section IV.

II. RELATED WORK

Wireless ad hoc networks and their protocols concerned many researchers. The investigate in this area [2], [3] and [4] has alert on the problems of the protocols. In [1] focus is on using directional antenna which is additional divided into busy-tone based protocols and non-busy tone based protocols. The subsequent sections present the protocols of both the categories.

A. Busy-Tone Based Protocols

Materials about busy tone established methods is really in prosperity. A DMAC that's tone based is introduced in [5]. But, there are many studies [5]-[8]on the Macintosh methods of kindbusy tone based. The protocol implemented in [5] utilizes two channels namely information funnel and manage funnel. The info channel is utilized to exchange real data packets while the control channel is only meant for sending a busy tone transmission. For every single node in the wireless system a busy signal is allocated and which can be recognized by nodes. Each node ought to get a hash table to preserve the places of other nodes in the community. The conversation in such sites is explained here. Whenever a source node has to send data to destination node, it has to deliver directional RTS packet towards destination. A directional CTS could be the reply from the destination. Thus source and destination nodes exchange data in specified directions. When the origin node locates a busy tone coming from destination rather than CTS packet, it considers the destination isn't obtainable proves that scenario of hearing loss as well as. Occasionally there's an opportunity to miss busy tone signal also. As a way to avert hidden terminal problem, the active tone signal really has to be sent along with all the RTS packet. Where communicating begins with DCTS / DRTS trade of packets in directional style the active tone signal sending from destination to source is suggested in [7]. Just a node misses DCTS package, it results in redundant busy tone. In [8] a method by name Dual-Busy-Tone Multiple Access with Directional Antennas(DBTMA/DA) is proposed to adapt the system with directional antennas.

B. Non-Busy Tone-Based Protocols

The first method of the kind is introduced in [9] that's based in the new 802.11 MAC method. It makes use of per-sector blocking mechanism once the process senses RTS (Request To Send) or CTS (Clear To Send as a way to block any field). Omni-directional way is utilized in [10] to exchange RTS/CTS packets. It will take place after formal protocol handshaking. This method is really capable of reducing hidden terminal problem. But, it can't handle deafness issue and also causes several exposed terminal issues. Multihop RTS MAC protocol is suggested in [11] which can make use of online transmission. Nodes may listen only in manner. On The Other Hand, there is certainly deafness problem. In [12] a method by title Directional Virtual Carrier Sensing is suggested where each node maintains listing of neighbors and corresponding directions besides Address of Coming (AoA) tips. It supports fundamental points of a directional antenna but can't handle deafness and hidden terminal problems.

Where in each way RTS must be sent multiple times a round directional RTS was proposed in [13] and [14]. Resource node place can consequently be recognized. Additionally it is possible to know the neighbours. Unwanted waste of time is reported in these methods because of the synchronization components. In addition they can't be useful for transmission and multicasting [6]. This paper presents the execution of the MAC process presented in [1] which overcomes difficulties of deafness, concealed terminal, and exposed terminal using directional antennas.

III. PROBLEM DEFINITION AND SYSTEM MODEL Problem Definition

Within the existence of directional antennas, three problems can occur, specifically deafness problem, hidden terminal issue and exposed terminal difficulty. The nodes located inside the coverage scope of destination node and away from the coverage area of supply node are reportedly hidden devices. They could cause degradation of the operation of community. The standard system like RTS/CTS can't fix this problem. More details of the difficulty can be found in [15].

Fig. 1 – Hidden Terminal Problems

As can be seen in fig. 1, the area denoted by *Ah* represents the possible presence of hidden terminals. In case of directional antennas, the showing terminal

problem has to be given more importance. In holder of ORTS/OCTS, nodes block sectors pointlessly thus wasting the change to obtain higher spatial multiplexing gain.

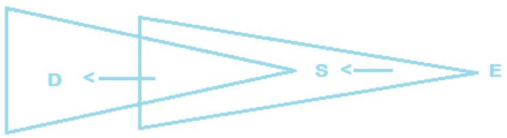

Fig. 2 –Deafness Problem

As is observed in fig. 2, deafness issues may occur in wireless ad-hoc systems when directional antennas are employed. It doesn't communicating with the location node, when a source node is pointed towards distinct destination. This dilemma is termed as deafness problem. As seen in fig. 2, the node E is trying to convey together with the node S whenever it is beam formed towards the node D. The outcome is that node E attempts to conduct data and consequently loose power and even it can determine that node S is not obtainable.

In addition to such issues, there's another issue identified. It's called asymmetry in gain problem. It happens whenever there are two types of transmissions which make use of same antenna. It could lead to asymmetry - in - gain difficulty, since there are different runs of transmissions simultaneously. The omnidirectional radiated signals and signals have transmission runs that are not identical. The end result is the fact that the control boxes that are transmitted omni-directional can't reach desired locations.

A. Antenna Model

In this document we suppose the antenna employed is having no sidelobes ideally. In comparison with mainlobes the region of these sidelobes is much smaller. Because of this the odds of discovering wireless nodes within the region of sidelobes is insignificant. But, an antenna controller is assumed which keeps track of directions that provides maximum signal energy. In 802.11, the SIFS (Short Disturbance Space) is described which is regarded long enough for an antenna that's changed between the receiving and transmission modes. Two distinct industries are used for data exchange and active tone signal respectively.

B. Busy Tone Signal

The model used for busy tone signal is a non-interfering sine-wave which lets other nodes to know the ongoing transmissions. Two patterns are used for this namely ON/OFF pattern and continuous pattern.

C. Effect of Mobility on MAC Protocols

Freedom has its impact in wireless ad-hoc sites. It could affect both MAC protocols and routing process. When there is mobility, as the Macintosh protocols are impacted when time scale of the changes as well as the time scale of MAC body are similar the routing protocols are to handle change in connectivity. However, the impact of flexibility is beyond the scope of this document.

D. DUAL SENSING MAC PROTOCOL WITH DIRECTIONAL ANTENNAS

The proposed dual detection protocol two different wireless stations generally known as data funnel, which is meant for sending data along with the control channel, which is meant for controlling the active tone transmission. It uses four directions specifically DCTS, DRTS, DDATA and DACK. The info funnel manages CTS, RTS, and ACK beside data packages.

E. DRTS/DCTS Communication

When a node's hyperlink levels receivepackets from other higher level, it is capable of feeling that in the specified path. In the needed direction the channel transmits DRTS packets and other directions, it shows a busy tone. When busy tone is thought by other nodes, they need to postpone DRTS before the busy tone vanishes. The receiver node responds to location node after SIFS interval with DCTS box in a particular direction. Then a BT2 is fired up at all guidelines. Then the node waits for information packet. As soon as data packet is successfully obtained it's acknowledged by the location node by moving a DACK packet in the exact same direction. Then its busy tone signal is switched off.

BT1 is used to cure the issue of concealed-terminal. This is because;the DRTS communication can't be thought by the nodes which are located within the hidden terminal area. When they feel BT1, they are able to avoid starting a new DRTS. To be able to avoid collision, the BT1has to be switched off once SIFS and DRTS are done as the nodes within the hidden terminal location will be able to sense CTS. In exactly the same style, BT2 is utilized to overcome the deafness problem. As given previously, this problem occurs whenever a node is directionally

obtaining or transmitting data, it isn't going to be able to listen to DRTS. When the origin finds a failed DRTS, it truly is supposed to check a BT2 from the receiver's direction else it must conclude a crash. In case when source node gets DCTS efficiently, it may transmit information package directionally without creating deafness problem. Afterward, when there is not DACK package received by source within ACK-timeout period, the transmission is rescheduled thus increasing its back away CW.

A. PROTOCOL VALIDATION

The validity of proposed MAC protocol is established using a tool by name SPIN (Simple Promela Interpreter). The tool is used to know whether the newly realize protocol is capable of solving the problems such as deafness, hidden incurable and exposed terminal in the presence of directional antenna. The SPIN verification results are presented in table 1.

Results of SPIN verification

Protocol	Blocking Free	Deafness Free
DMAC	Not Valid	Not Valid
MMAC Tone	Not Valid	Not Valid
DMAC	Valid	Not Valid
DBTMA/DA	Not Valid	Valid
DSDMAC	Valid	Valid

As can be seen in table 1, it really is obvious that the proposed MAC protocol is also deafness free and both blocking free. The results also show the proven fact that transmitting RTS/CTS omni directionally in DMAC can block node 5 while nodes three or one can begin communication with node 2. When node three overlooks node 2's CTS, it also causes deafness problem. In this instance MMAC also failed. While DBTMA / DA is not obstructing free tone DMAC isn't deafness free. The proposed strategy is confirmed to be blocking free and deafness free.

IV. EXPERIMENTAL RESULTS

Experiments are made using NS2 simulator. The system parameters used in both the analysis and simulation models are summarized in table 2.

Parameter	Value	Parameter	Value
PHY	DSSS	Propagation Delay(o)	1 [IS
cw_{mb}	32	M	7
cvu	1024	Packet payload	12000 bits
Channel Data Rate	11Mbps	MAC Header	272 bits
Basic Data Rate	1Mbps	PHY Header	192 bits
SIFS	ID [is	ACK	304 bits
DIFS	50 [is	RTS	352 bits
Slot Tune (o)	20 [is	CTS	304 bits

As can be seen in table 2, there are many system parameters and their values. These are used for both analytical model and simulation models.

PERFORMANCE ANALYSIS

This section provides details of analysis with respect to PDR and delay. Analytical models have been developed for both of them. The analysis is based on the following assumptions.

- All nodes in the wireless ad hoc network identical having same kind of antennas.
- Antenna sectors are associated with each node that can be switched to any direction.
- During communication busy tone signal can be communicated through all unused sectors.
- Nodes are randomly distributed.

The graph presented in this section show the throughput and collision probabilities respectively.

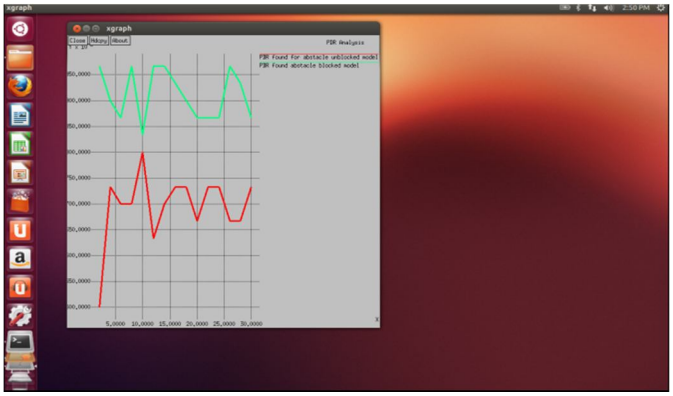

Fig. 3 –Packet Delivery ratio observed

As can be seen in fig. 3, it is evident that 1, 4, 8 and 16 antenna sectors are used. The average number of nodes per hop is presented in horizontal axis while the vertical axis presents pdr

V. CONCLUSION

Within this paper we have implemented the Macintosh protocol based on double detection method using NS2 simulator. The applied protocol is intended for wireless multihop ad-hoc networks. The network employs directional antennas. The current protocols could use directional antennas but not able to manage issues like deafness, concealed fatal and uncovered terminal. These problems are overcome by the proposed implementation grounded in the double detection method. Afterwards, the Spin tool is used to confirm the integrity of the method. The simulation results are compatible with analytical model presented within this document. The proposed MAC protocol is capable of enhancing the operation of wireless networks with directional antennas.

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