

Hidden Node Problem in Wireless Ad-Hoc Network

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Abstract

The term wireless Ad Hoc network is used for the type of network that is established between communicating nodes for the specified period of time. After sometime, the nodes involve in the network move to the other location. This happens due to the wireless ad hoc network is made up of multiple mobile nodes. Moreover, user always wishes to get connected with the nodes even if he/she changes its location. However, each time user changes location, the device of the user become hidden for the other nodes involved in the network to which the user's node was connected. This sometimes becomes large problem named collision. This study provides the information related to hidden node problem and it also enlists some of the mechanism to avoid the hidden node problem. Moreover, if the hidden node problem occurred in network, even if after applying these mechanism some of the solutions to be applied to solve this problem. This study discussed about some of the useful solutions that can be applied to solve hidden node problem occurs in the network.

Keywords: Hidden Node Problem, Avoidance of Hidden Node Problem, Solutions to Hidden Node Problem.

I. INTRODUCTION

Mobile Ad hoc network (MANET) is the collection of mobile nodes that changes their location on the fly. MANET is a temporary based wireless network which does not rely on the infrastructure, that is it a decentralized kind of network. This helps people to get connected with any nearby device even if they change their location very often, regardless of their underlying architecture and location. Mobile ad hoc network gains its popularity from the use of wireless communication. As large number of people communicated through wireless medium and wants to get connected to other devices whenever requirement arises or even stay connected even if they frequently change their locations.

Mainly there are two parties involved in Mobile ad hoc network such as, communicating nodes and access points. The communication nodes are the end points in the network that are connected to the other nodes in the network. An access point in the network is a hardware device that allows nodes in a network to get connected to other nodes in network. The communication between the nodes in the network can be shared by access point[1].

II. HIDDEN NODE PROBLEM

A hidden node in a network is a device that is visible to the access point but not visible to other nodes attached to the access point. If multiple devices try to send data to the access point at the same time, collision will occur at access point as other nodes are hidden from each node in the network. Hidden node problem can be observed in widespread WLAN setups with many nodes that use directional antennas and have high uploads. Suppose that in a network of three nodes, in figure 1, Node A, Node B, and Access points, if two nodes send data to the access point, may results in collision. This is so because, node A and node B is directly connected to access point but does not visible to each other.

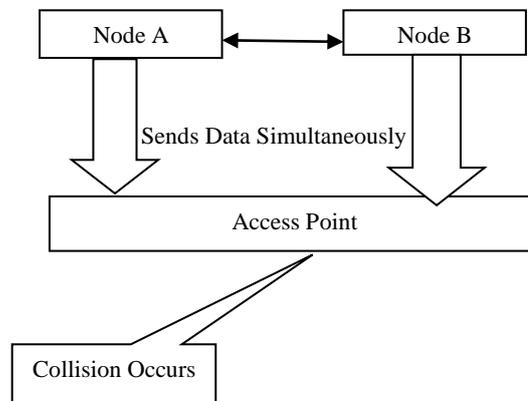


Figure 1: Hidden Node Problem

III. REVIEW OF RELATED WORK

Nishu Jindal and Paramjeet Kaur states the introduction about the hidden node problem. They describe the hidden node problem in multihop network. They also propose the solution to the hidden problem in their study. They use method of RTS/CTS for finding the hidden nodes in the network and also integrate RTS/CTS with RTR method to solve the various deficiencies in RTS/CTS method. They compare the performance of both RTS/CTS and RTS/CTS with RTR method for solving the hidden node problem. They took three parameters for comparison i.e. Time, Throughput, and Energy Consumption[1].

Ko Shibata , Munehiro Takimoto, and Tasushi Kambayashi states the hidden node problem by connection of multiple robot with a wireless MANET. They identify that number of robots involved in the network does not have any idea about the other robots in the network. They employ the visible ray concept to widen the control scope so that they stray robot can move into radio communication range. They apply this experiment onto two robots i.e ground robot and aerial robot, that share signal by light. Ground robot when wants to communicate with other hidden robots, it issues a signal to aerial robot and that aerial robot tries to find the other robot in network for communication [2].

L.Boroumand, R.H. Khokhar, et. Al. describes the design factors to deal with hidden node problem avoidance. They classify and characterize these mechanisms into three categories, such as handshaking, busy tone multiple access, and routing management mechanisms. They also highlight the open issues in hidden node problem[4].

IV. MECHANISM TO AVOID HIDDEN NODE PROBLEM

Hidden node problem basically occurs more likely in wireless networks as most of the wireless networks are based on the topology and range of the nodes. If multiple nodes in wireless network tries to send data to the common receiving node then, collision at receiving node. This cause the corruption of data of both sending nodes. So to avoid such problem, there should be a mechanism to be used so that nodes before sending data to any node must check whether the receiving device is free to receive its data or is busy in communicating with other nodes in the network. In this section, we summarizes some available mechanism to the problem of hidden node.

A. Handshaking Procedure(RTS/CTS method)

To avoid collision at receiving end all the neighboring nodes needs to inform that channel will be occupied. This can be achieved by reserving the channel using control messages, which is handshaking protocol. Data collision caused by hidden node problem A message termed as RTS (Request To Send) is send by sender to receiver, which indicates the request of the sender about asking that if receiver is ready to

receive or not. A message termed as CTS (Clear To Send) is send by receiver to send only when it is ready to receive. Moreover, wireless network is a broadcast network, when RTS/ CTS messages are broadcast in network, all the neighboring nodes of sender and receiver will be informed that medium is busy. Thus, preventing them from transmitting and it results in avoidance of collision.

B. Multiple Access Collision Avoidance (MACA)

Multiple Access Collision Avoidance (MACA) is used to avoid collision occur by the hidden node terminal. In MACA the sending device make an announcement before it start sending data to the intended receiver, so that other nodes in network keep salient at the time of data transmission. When sending device sends RTS to receiving device, the receiving device if ready to receive it sends CTS plus the maximum length of data it is ready to receive. A node that hears RTS keep salient for avoiding conflict with CTS and vice versa.

C. Busy Tone Mechanism

Busy Tone Mechanism allows the parties involved in transmission of data, i.e. sender and receiver to send a control message named Busy Tone to their neighbor. This improves efficiency by providing allowance to the sender and receiver to reserve the link for the transmission. Moreover, some of the mechanisms like FPDBT (Fixed Power Dual Busy Tone), VPDBT (Variable Power Dual Busy Tone) etc. work on the power that should be used to transmit the control message.

D. Node Grouping Mechanism

Nodes are grouped according to the hidden node relationship, means the nodes are grouped according to the visibility of each other. These groups are scheduled to communicate in non-overlapping manner to avoid hidden node problem.[5]. This grouping is widely used in star based network ZigBee network. ZigBee network is designed for low power consumption, so that batteries can lasts for months or even years.

V. SOLUTION TO AVOID HIDDEN NODE PROBLEM

The various methods which can applied to solve hidden node problem is explained in this section:

A. Increase Transmitting Power from Nodes

Increasing in transmitting power can solve the hidden node problem. This is done by

increasing the cell power of the nodes so that the nodes can become capable of sensing in large range at higher range and non hidden nodes can sense the hidden nodes involve in the network. If all the nodes can sense or detect the other nodes involved in the network then hidden node problem vanishes at greater extent [6]. This is so because wireless network is based on CSMA/CA protocol, so each node when starts transmitting data, first sense the network channel, if it is busy then node have to wait for certain period of time for channel to be free, but if channel become free the node can sends its data to the receiving node.

B. Use of Omni Directional Antennas

The nodes involved in the network can use both directional and Omni directional antennas to sense the other nodes in the network. The nodes that uses directional antennas can only sense the nodes includes in the direction follows by the directional antenna, all other nodes involved in the network are hidden nodes. However, this causes the hidden node problem to greater extent. So the better solution to this problem is that each node must use Omni directional antennas to sense all nodes involved in the all direction in the network. This solves hidden node problem as if all the nodes can sense the other nodes in network can wait for their turn if the communication channel is held by some node in the network.

C. Moving the Nodes

The alternative method for solving hidden node problem is the movement of the nodes so that each node detect other nodes involved in the network. If it is found that the movement of node occurs the hidden node problem then, it is compulsory for the moved node to move to the same direction back to become non hidden node again. The other way of forcing node to move is to extend the wireless LAN to add proper coverage of the hidden nodes. This may be done by increasing access points, or increasing the sensing power of the nodes involved in the network.

D. Protocol Magnification Software

If the network is based on the poll and select method then the problem of hidden node may be solve very easily. In poll and select method the nodes are divided in two categories like primary and secondary nodes. The primary node polls the secondary node to send data in round robin fashion. Then primary node selects the secondary node to receive data sent by the secondary node. Each time if the secondary node wants to communicate with other secondary node it is done with the primary node as an intermediate node. The primary node is access point and the secondary nodes are the communicating node in the network.

VI. CONCLUSION

In nutshell, the wireless ad hoc network is the infrastructure less network that changes their location and gets connected with other nodes in the network on the fly. In this type of network the number of nodes involved in the network is very large. The nodes in the network shared data with help of the node termed as access point. Each time, the node wants to send data to any other node, it will first send that data to access point, then that access point sends data to other receiving node.

Each node is sensed by the access point, but may or may not through the other nodes in the network. If multiple hidden nodes send data to the access point at the same time then collision occurs. So, it is necessary to avoid the hidden node problem. In this study, we found the methods to avoid hidden node problem occurring in the network. Moreover, if by chance the hidden node problem occurred even if the avoidance mechanism applied, then it is required to solve this problem. In this paper, we studied some of the solution can be applied to solve the hidden node problem. The future aspect of this study is the mechanisms involved in detecting the hidden node problem by simulating the behavior of the network.

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