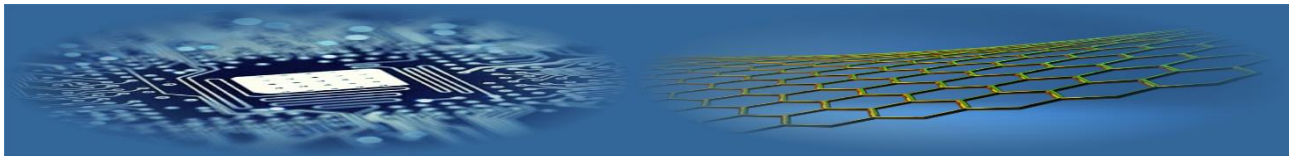

Border node detection: a new experimental approach

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Abstract

This paper aims at sensing the network, and detects the border nodes, the researcher use NS2, in order to represent, simulate and calculate the delivery ratios of the distributed packets which accordingly will help to detect the border nodes. The importance of this research comes from detecting the border nodes without depending on other resources, since Ad hoc networks coordinates are virtual. The researchers analysed the results of the trace file that came as an output of carrying out simulations in Network simulator (NS2) for the evaluation of the ratios. The methodology of this experiment depends on using the IEEE 802.11 MAC protocol. Flooding technique was used to send data packets through three scenarios: First, 5% of the nodes are randomly chosen to send their data packets per minute. In the second and third scenarios, the percentages of nodes that flood their data are 25% and 50% respectively.

Keywords:

MANETs, Broadcast, NS2, IEEE 802.11, MAC, Flooding

1 Introduction

The wireless network is a system of nodes (sensors, laptops, etc.) where each node collects and exchanges the information without any infrastructure (bridge and access point). Ad Hoc and Infrastructure are two classifications of the wireless network [1].

Ad Hoc networks are used in many fields of interests such as mobile and wireless Ad Hoc networks, wireless Local and Personal Area Networks, Quality-of-Service Issues, performance of protocols and many other issues [1].

Coordination of the messages flow through the network in Ad hoc networks does not depend on physical base station or routers, nodes of the network sends messages to each other. The original Latin word "Ad hoc" means "for this", leading to the purpose of this network "For this purpose" [1].

Ad hoc networks may contains many types of nodes, this paper aims at detecting the border nodes for if the node is a border node, it is not essential to broadcast all messages it receives; and this will enable saving energy used in messages transmission. Moreover, the border node is threatened to leave the network area at any time. Therefore, it has to be given higher priority when it has data to send. In addition, this unstable existence of the node is crucial for some network applications such as routing. Routes based on this node are considered weak or unstable.

2 Related works

Ad Hoc is a decentralized network consists of nodes that interface and exchange information between each other without any need for infrastructure. Each node has two main systems: the computing and communication systems. Mobile Ad hoc Network (MANET) beginning was in The 1990s, and introduced as a special case of Ad Hoc network. It has been considered as one of the biggest challenges since its beginning in wireless networks field. The main difference between Ad Hoc and MANET was the mobility of the nodes [14]. MANETs became popular research topic since the mid-1990s due to the high growth of laptops and 802.11/Wi-Fi wireless networking.

For achieving the main purpose of MANET network some obstacles need to be overtaken like the mobility that leads to dynamic topology which causes changing routes, losing packets, breaking the links [2]. Also, there are other challenges such that the limitation of the wireless transmission range, battery lifetime, bandwidth, the variable capacity links, the high cost of money, the low security and at the end the self-organization. Despite all these obstacles , MANET is used frequently in many significant fields like; smart cities, ambient intelligence, pervasiveness, monitoring, controlling, mobile social networking data dissemination, Road safety, traffic efficiency, infotainment, rescue, home network and much more [6, 7].

The nodes that know their exact locations are located at fixed points or have Global Positioning System (GPS) [16]. However, the use of GPS is not always available or facilitated in the case of MANETs. Also, for more accuracy some nodes depend also on two measurements; distance and angle measurements. Distance measurement has attracted many attentions since it relies on measuring the range wireless signal transmission by using many methods like RSSI, TOA and TDOA [15].

Link reliability, Noise and hard environment conditions may reduce the RSSI accuracy while the problem that faces TOA and TDOA is the non-rigidity of the graph. The second measurement is the angle which requires more cost due to the multiple receivers or the antenna array on nodes. Angle

of Arrival (AOA) is an example of angle measurement. Many other approaches are proposed like anchor based localization or centroid method which is also known as a reference node [5, 8, 15]

A homogenous network is the one with the nodes that have the same characteristics and communication capabilities, while heterogeneous network contains different types of nodes. Although heterogeneous networks are hard to deploy due to the different communication capabilities and resources, they is more realistic than the homogeneous networks [9]. Military fields are an obvious example of heterogeneous networks when helicopter, army vehicles, and ambulances communicate with each other. Border node or gateway node is a node that has at least one or more neighbours that belong to different networks. It is considered important to secure the network from any attack and help intra-cluster and inter –cluster routing. Service Border Nodes (SBNs) offer many services between the different MANETs like forward and store the service discovery information. Moreover, they can do the aggregation of service information and routing information about the MANETs networks. One of the main functions of the border node is to prevent or allow the nodes or agents to be accessed between the MANETs too [3, 9].

Figure 1 demonstrates a show case of the importance of border node or gateway node is obviously clear in the clustering algorithms. Clustering is a natural arrangement of nodes in different groups [12]. Within each cluster there is a cluster head that aggregates and collects the data from all node members then sends the information to the base station. However, the cluster heads are connected with each other directly or by using border nodes or gateway nodes. The cooperation between cluster heads and gateway nodes form a backbone that lead to provide a high scalability in the large networks, and prolong the network lifetime [12].

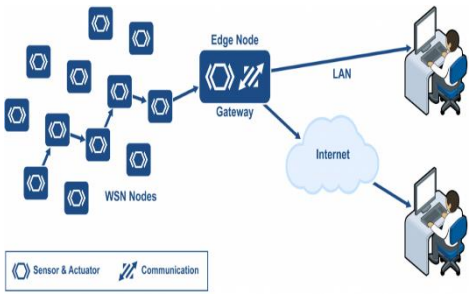

FIGURE 1 The use of border Nodes as Gateways

Border nodes can play a major role in Routing [1]. The Routing protocol is defined as a combination of roles for selecting the data packet path from a source to any destination across the network. In spite of determining the path in decentralized environment it is a bit difficult with the dynamic topology. Many approaches were proposed over the last decade. Two classifications were introduced, the topology based routing protocols and the position based routing protocols. Topology based routing protocols need to make the routing decisions by the information about the virtual links .While, the position based routing protocols need the physical locations of the nodes by using the location service. Position based routing protocols become more significant because there is no need for maintenance or establishing the route, which reduces the network overhead in general. Thus, the only information that the sender node needs to know is the position of the destination node [15].

A location service is a software application that proposes knowledge about where nodes are located. Many routing protocols apply the location services with very restricted conditions. Most Forward within Distance (MFR) is a routing protocol that orders each node to broadcast beacons message to announce its position in a periodic way [10]. Besides that, many other routing protocols have their restricted conditions about the location services like DREAM routing protocol that is proposed by Basagni et al. [4]. DREAM uses the information from GPS systems to complete the communication process. Location-Aided Routing (LAR) is a position based routing protocols that is proposed by K. Young and V. Nitin [11]. As DREAM routing protocol GPS is used for obtaining the nodes geographical information. Using GPS has many advantages and disadvantages, reducing the network overhead and bandwidth utilization are obvious advantages. On the other hand, GPS service is not granted by all networks as a facility, in addition; this service consumes the battery life rapidly [1].

3 The proposed method

Text should be produced within the Scenarios modelled Network Simulator is a simulate network platform that plays a major role for testing, developing and evaluating any network type. Usually, it is highly used in academic studies, development and research. However, some important performance metrics are used like time, packet loss ratio, speed, delay, throughput, energy, and bandwidth. NS2 is an open source network simulator that uses many programming languages like, Tcl, Tk, C++, and Otcl. NS2 supports MANET and Ad Hoc network types too [13].

The Flooding is a technique that is used to send the same message to all over the network. To execute this technique there are some common steps that should be followed. First of all, the node should send the data packet to its neighbors, the second step, each node that receives the data packet has to forward it to its neighbors until the data packet reaches all the nodes in the network [15]. However, to avoid forwarding the data packet more than once, a sequence number is used. The Flooding technique has some advantages and disadvantages. Although, the simplicity and the high reliability of delivering the data are advantages, the high overhead is a very significant disadvantage. This technique is somehow useful when there is a rapid change in the topology with a small data packet.

The simulations model contains 100 nodes with a non-uniformly distributed over a 1000m x 1000m. The node movements are based on the random-waypoint model (RWP) [2]. The IEEE 802.11 MAC protocol uses a simulation time of 800 seconds and a pause time of 1 second is also applied in the RWP model. The node speed which is 10 meters per second is applied. The flooding technique is used. There are three scenarios. In the first scenario, in each minute 5% of the nodes have been chosen randomly for sending their data packets. In the second and third scenarios, the percentages of nodes that flood their data are 25% and 50% respectively.

TABLE 1 Simulation parameters

Value	Parameter
100	Total nodes
random-waypoint model	Movement model
10 m/sec	maximum speed
1 second	Pause time
IEEE 802.11	MAC protocol
1000m * 1000m	Simulation area

3.1 ALGORITHM

Python language is used to analyze the NS2 result file. The python code builds two matrices:

-The first matrix or ratio matrix calculates the ratio of the sent data packets (s) over the received ones (p); s / p. This equation is calculated for each single node over the whole 800 seconds.

I.e: the delivery ratio used in this methodology to detect the border nodes is the ratio of: (#packets received (receiver)/ number of packets transmitted (sender)).

The second matrix contains three steps.

A– The coordination as (x, y) is written for each single node over the whole 800 seconds.

B– If the x and y values for a specific node are under this condition;

(x<25.0 or x>975.0) or (y<25.0 or y>975.0) it is considered as a Border Node (B) .Otherwise, the node is not a border Node (NB).

C– The number of times that the nodes are defined as a border node over the total numbers: (B) / (B + NB)

4 Experimental results

After comparing the two matrices with each other.

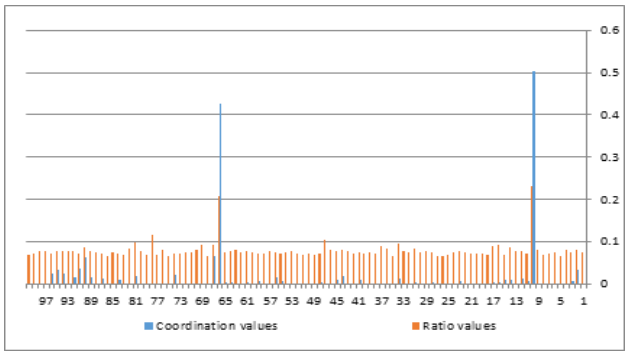

FIGURE 2 Ratio with 5% of the nodes number broadcast

The line chart illustrates two lines, the coordination and the ratio values. The x axis presents the nodes number. From the charts there is an obviously relation between the coordination value and the ratio value. Nodes number 10 and 66 have considerably a peak in their ratio values. As a result if the ration value is high this means that the node is a border node.

The first line chart shows the scenario with 5% of the nodes number that send data each minute. While the second and third line charts show the sent data from 25% and 50% of the total number of nodes.

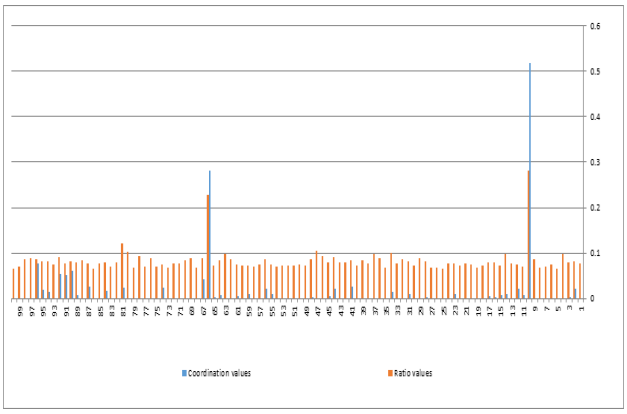

FIGURE 3 Ratio with 25% of the nodes number broadcast

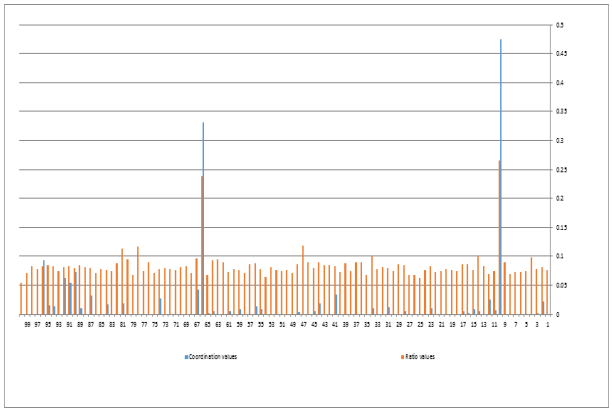

FIGURE 4 Ratio with 50% of the nodes number broadcast

5 Conclusion

In this paper, the proposed algorithm applied a sender/receiver ration to detect border nodes. NS2 as a simulator platform is used to create MANET network and apply the ratio. The simulation results show a positive relationship between the coordination and the sender/receiver ration of the nodes. The border nodes without relying on any extra resources or even over heading the network by broadcasting messages can be detected.

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