A Framework for Localizing and Neutralization of Jammers in Wireless Networks.

Nikhil H Joshi
P.G Student :I.S.E Dept.,
National Instituteof Engineering,
Mysore,India.
Nikhiljoshi044@gmail.com

Dr. H.D. Phaneendra
Professor:I.S.E Dept.,
National Instituteof Engineering,
Mysore,India
hdphanee@yahoo.com

Abstract—The communication in wireless networks can be severely interrupted by Jammers and information about the jammers position can help to eliminate its attack. The main approach of this paper is to localize and neutralize the jammer in the network based on the energy(JSS) and finding the new route through the network i.e., best route through the network. The best route is defined as the minimum distance in the network that a sender node selects as its boundary or next hop node Thus, in this paper we aim to design a frame work to localize multiple jammers with high accuracy and minimal error factor. An effective means is to measure the strength of jamming signals (JSS). It conceives an evaluation feedback mechanism for localizing jammer as non linear optimization problem, to quantify result close to true jammer position. This paper focuses on localizing multiple jammer considering energy(JSS) as parameter for identifying a node as a jammer and using another parameter i.e., distance between nodes along with their energy(JSS) to find a best path for the communication in a network jammed scenario.
Keywords—*jammer, localization, neutralization, best route.*

*****

I. INTRODUCTION

The rapid and prolong development in wireless technology led to a new class of application utilizing wireless sensor networks, namely Industrial automation ,Traffic surveillance ,monitoring and Air traffic control considering the availability of wireless signals. A sensor node is capable of sensing, gathering, processing and communicating data. Hence the underneath technology plays an important role for proper functioning of the application, any issues results in abrupt functioning. Once such issue which severely affects the communication is the jamming attack. Defining the position of jammer it is important to provide security to such attacks and refine the network communication. The scenario should be such that a network should be capable of finding physical location of jammer and exploit security strategies to provide various defense mechanisms at various layers. To effectively utilize the resources available, once the jammer position is available it should be eliminated from the network, a new route is selected which does not traverse the jammed network .This paper focuses on localizing multiple jammer considering energy as parameter for identifying a node as a jammer and using another parameter i.e., distance between nodes along with their energy to find a best path for the communication in a network jammed scenario.

1.1 Jammer attack in wireless networks:

Jammers can be classified on the effects caused on the wireless communication channel as:

A. Constant jammer: A jammer which send random and irreverent signals to the channel affecting the MAC protocols. It does not depend on the state of the channel.

B. Deceptive jammer: It transmits valid data packets into the channel with or without payload and deceiving the normal nodes as it check the preamble.

C. Reactive jammer: It a type that have capability to sense the channel and is continuously on and non energy conserving, the jammer does not transmit in idol state of the channel ,but as soon as it sense any activity it starts emitting radio signal which interrupt with the normal communication.

D. Random jammer: This jammer is characterized by series of ON and OFF behavior of the jammer. The ON is depicted as the time duration when the jammer is emitting signals and OFF for no activity. The duration for ON and OFF are fixed or random.

1.2 Interference Level in wireless sensor network

The level of interference caused can be used to define the distance between the jammer and other nodes. It also defines the relative transmission power between the two. These two parameters can be used to actively neutralize jammer, and it uses MAC protocols in wireless communication.

II. EFFECTS ON NETWORK TOPOLOGY DUE TO JAMMING

In this paper we focus the effects the nodes have due to the jammer at the network level to an individual node level. Due to jammer the changes in the neighboring nodes contribute to the classification of the network nodes as:surrounding nodes gets affected, and we classify them based on its effects. The hearing range from all the nodes contribute to the detection of the changes in the neighboring nodes in WSN two nodes x and y are considered to be neighboring nodes if both of them are capable to receive signals from each other. Under jamming attack the level of changes in the neighboring nodes contribute to the classification of the network nodes as:

- **Jammed Node:** A node is considered to be jammed node if it is not capable to send and receive messages to the other nodes surrounding it. This type of node can measure JSS but may not be able to report it

 ISSN: 2321-8169
2851 - 2853

always. This kind of node don't have any unaffected nor boundary node in its surrounding cluster.

- **Unaffected node:** A node is considered to be unaffected node if it can send and receive messages to all of its surrounding nodes. Its hearing range is not affected compared to other nodes. Since it is not affected by jammer, it is not able to report JSS measurement.
- **Boundary Node:** A node is considered to be boundary node, if it is able to send and receive messages to some of its neighbors but not all of them. In this type of node the hearing ranges is reduced and is capable to measure and report its JSS measurement to the designated node.

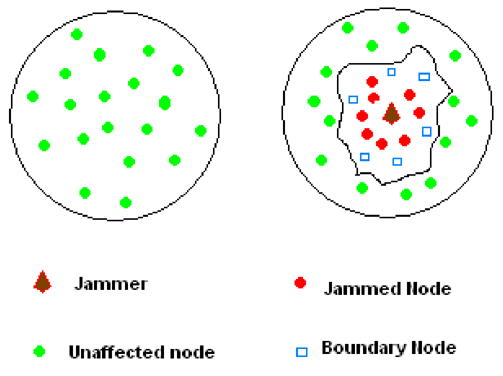

FIGURE A: Node classification based on jamming effect.

The above figure gives a pictorial representation on the classification of nodes based on the jamming effect. Before jammer is active , the figure shows green dots which can communicate with all other nodes and are called unaffected nodes, once the jammer is active shown as brown diamond , the nodes in its vicinity are not able to communicate with any of the nodes shown as red dots and are known as jammed nodes. But, there are some nodes which can communicate partially with some of the neighboring nodes shown as blue box are known as boundary nodes. These nodes play an important role in localizing a jammer since they can measure and report JSS to a designated node.

III. LOCALIZATION FORMULATIONS

For localizing jammer the following mechanism is followed and is depicted as:
The estimation obtained for a single location, a number of JSS measurement values are considered .These values are provided as a quantitative evaluation feedback which indicates the distance between the true jammer and estimated jammer location. It is the basic idea to approach for localization problem in jammer. The two are the important steps followed for this approach:

1. The collection of JSS values obtained from various boundary nodes, since these node are capable of measuring and reporting JSS values.

2. The estimated results are evaluated to obtain a best value of the collected JSS values .Based on the jammer position through rough estimation a designated node is obtained. The estimated results are refined by searching for positions which minimizes the evaluation feedback metric. The following algorithm is used to determine the best estimation for localizing a jammer.

Algorithm used for finding the best estimation for jammer.

A: m = JSSMesurement()
B: I = Initial positions
C: while Terminating Condition True do
D: eI=MetricEvaluaton(I, m)
E: if NotSatisfy(eI) then
F: I = SearchToFindBetter()
G: end if
H: end while

The following are the few challenges subtasks that are followed:

A) Sometimes the JSS are embedded into other transmission signals, the JSSMesurement () is used to calculate the values of JSS.

B) MetricEvaluaton () used to define an appropriate metric which quantifies the accuracy of estimated jammers locations.

C) To obtain the best estimation value the SearchToFindBetter () method has to be efficient.

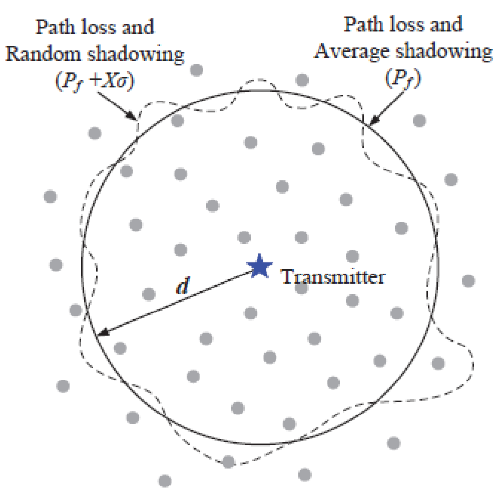

FIGURE 2: The irregular loop defines the RSS attenuation and the circle centered on transmitter is the path loss.

IV. RADIO PROPAGATION BASICS

In wireless communication systems the sender to receiver distance plays an important role. The receiver signal strength is attenuated by various factors such as shadowing phenomenon, path loss and addition and deletion of various signals into the original signal as the distance between sender and receiver is increased. With the transmitter situated at the center of the circle the attenuation due to shadowing phenomenon is consider to be irregular from d meters from the transmitter. There is an average attenuation and average signal strength for the transmitter. The above mechanism acts as base for localizing jammer.

Assuming that each jammer is equipped with an omni-directional antenna and it emits radiation equally in all directions; hence the range for each jammer is similar. The network is able to detect the jamming effect and estimate the number of jammers present based on the effect. Hence neutralization of the jammer is done through the network itself. The main approach of this paper is to localize and neutralize the jammer in the network based on the energy(JSS) and finding the new route through the network i.e., best route through the network. The best route is defined as the minimum distance in the network that a sender node selects as its boundary or next hop node.

4.1 Localization Evaluation Metric

This section focus on the property, calculation and definition of evaluation metric eI:

4.1.1 The property of eI:

While defining the eI should have the descriptive property : if the estimation errors of jammers locations are the larger, the eI is larger. When defining ez as the estimated standard deviation of Xσ which has been derived from the estimated jammers' locations. Consider the one-jammer case, where the estimated jammer's location are equals the true value, and eI is the real standard deviation of Xσ , which is relatively smaller. When there is an estimated error defined (the estimated location is ed distance away from the true location), eIwill be considerably biased and will be larger than the real standard deviation of Xσ. The level of bias is affected by ed: the larger ed is, the **Single Jammer.**.

4.1.2 Problem Formulation:

By the definition of the feedback metric (eI),it is generalized that jammer localization problem as one optimization problem,
l Problem 1: minimize eI(I,m) I
subject to p = {Pr1 , . . . , Prm }; (1)
where z are the unknown variable matrix of the jammer(s), e.g., z is defined as, and {Pri }i∈[1,m] are the JSS measured at the boundary nodes {1, . . . , m}.The estimated location(s) of the jammer(s) at which ez gets minimized, matches for the true location(s) of jammer(s) with small estimation error(s).

V. PERFORMANCE VALIDATION

By studying three search algorithms for best estimation for finding the location of jammer like genetic algorithm (GA), a generalized pattern search (GPS) algorithm, and a simulated annealing (SA) algorithm, for the factors like jammer power,node density and number of jammer it is fesible to use direct measurement i.e., JSS compared to indirect ,for localizing jammers in networks. The network should be able to neutralize jammer and find a better route through the network.

VI. CONCLUSION

In this paper the focus is on localizing one or multiple jammers based on JSS and are able to neutralize jammer through network, such that jammed nodes does not take part in routing in network. The main approach of this paper is to localize and neutralize the jammer in the network based on the energy (JSS) and finding the new route through the network i.e., best route through the network. The best route is defined as the minimum distance in the network that a sender node selects as its boundary or next hop node. By defining evaluation feed back mechanism which quantifies to localize jammer accurately. Hence by studying search algorithms, the direct measurement i.e., JSS measurement is more accurate to localize jammers in wireless network.

REFERENCES:

[1] K. Pelechrinis, I. Koutsopoulos, I. Broustis, and S. V. Krishnamurthy, "Lightweight jammer localization in wireless networks: System design and implementation," in *Proceedings of IEEE GLOBECOM*, 2009.

[2] H. Liu, Z. Liu, Y. Chen, and W. Xu, "Determining the position of a jammer using a virtual-force iterative approach," Wireless Networks (WiNet), vol. 17, pp. 531–547, 2010.

[3] Z. Liu, H. Liu, W. Xu, and Y. Chen, "Exploiting jammingcaused neighbor changes for jammer localization," IEEE TPDS, vol. 23, no. 3, 2011.

[4] H. Liu, Z. Liu, Y. Chen, and W. Xu, "Localizing multiple jamming attackers in wireless networks," in Proceedings of ICDCS, 2011.

[5] T. Cheng, P. Li, and S. Zhu, "Multi-jammer localization in wireless sensor networks," in Proceedings of CIS, 2011.

[6] Wood, J. Stankovic, and S. Son, "JAM: A jammed-area mapping service for sensor networks," in Proceedings of RTSS.

[7] W. Xu, W. Trappe, Y. Zhang, and T. Wood, "The feasibility of launching and detecting jamming attacks in wireless networks," in Proceedings of MobiHoc, 2005.

[8] Goldsmith, Wireless Communications. Cambridge University Press, 2005