Securing Communication in MANET through E-GAMAN Algorithm

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Abstract : MANET consists of mobile nodes that are in radio reach of one. Each of the nodes has a wireless interface to correspond with one another. All networking functions, for example, routing and data transmission, are performed by nodes themselves in an organizing toward oneself way. Because of these reasons, securing communication in MANET is extremely difficult. In this study, we proposed an improved Qos routing algorithm for MANETs called E-GAMAN. The proposed methodology has two algorithms: SSRA and GAMAN. Simulation results show that E-GAMAN algorithm has a great execution and is a guaranteeing algorithm for Qos routing in MANET.

***IndexTerms* – secure communication, MANET, Qos, Qos routing, E-GAMAN, SSRA, GAMAN**

I. INTRODUCTION

MANETs are the autonomous distributed systems that comprise a number of mobile nodes connected by wireless links forming arbitrary time-varying wireless network topologies. Mobile nodes function as hosts and routers. As hosts, they represent source and destination nodes in the network while as routers, they represent intermediate nodes between a source and destination, providing store-and-forward services to neighboring nodes. Nodes that constitute the wireless network infrastructure are free to move randomly and organize themselves in arbitrary fashions. Therefore the wireless topology that interconnects mobile hosts/routers can change rapidly in un-predictive ways or remain relatively static over long periods of time [2]. These bandwidth-constrained multi-hop networks typically support best effort voice and data communications where the achieved "good put" is often lower than the maximum radio transmission rate after encountering the effects of multiple access, fading, noise, and interference, etc. In addition to being bandwidth constrained, mobile ad hoc networks are power constrained because network nodes rely on battery power for energy. Providing Qos (quality-of-service) or secure communication support for the delivery of real-time audio, video and data in mobile ad hoc networks presents a number of significant technical challenges.

Quality-of-service (Secure Communication) is the qualitatively or quantitatively defined performance agreement between the service provider and user applications based on the connection requirements.

The Secure Communication requirements of a connection are a set of constraints such as bandwidth (available bandwidth) constraint, delay constraint, jitter constraint, loss ratio constraint, and so on.

The Secure Communication condition of a network reflects the network's ability to provide the specified service between communication pairs. Because of the rising popularity of multimedia applications and real-time services, which require strict bandwidth/delay constraints, together with the potential commercial usage of Ad-Hoc networks, Secure Communication support in the MANET has become a topic of interest in the wireless area [9].

II. SECURE COMMUNICATION ROUTING IN AD-HOC NETWORK

Many Secure Communication components should work together to support Secure Communication in Ad-Hoc networks: a Secure Communication model specifies which kinds of services to be included in the network; a Secure Communication routing scheme searches a path with satisfactory resources defined by the Secure Communication model; a Secure Communication MAC protocol solves the problems of medium contention; a Secure Communication signaling protocol performs the resource reservation along the path computed by the Secure Communication routing protocols. Among all these components, Secure Communication routing is a key issue.

The goals of Secure Communication routing are: 1) selecting one or more network paths that have sufficient resources to meet the Secure Communication requirement of connections, 2) provide resource information of the path for admission control (call acceptance) mechanism, and 3) achieving global efficiency in resource utilization. Secure Communication routing in Ad-Hoc network is difficult. First, getting and managing the link state information (such as delay, bandwidth, jitter, cost, loss ratio and error ratio) in MANET is not trivial because the quality of a wireless link changes with the surrounding circumstance [5]. The larger the size of the network, the more difficult it is to gather the up-to-date information. Second, the resource limitations and the mobility of hosts make things more complicated. Third, if the Secure Communication request includes two independent path constraints, path searching becomes NP-complete.

III. MANET

A MANET (Mobile Ad-hoc Network) is a collection of autonomous mobile nodes that can impart to one another by means of radio waves. The mobile nodes that are in radio reach of one another can specifically convey, although others needs the support of moderate nodes to course their parcels. Each of the nodes has a wireless interface to correspond with one another [6]. These networks are completely distributed, and can work at wherever without the assistance of any settled foundation as access focuses or base stations, All networking functions, for example, routing and parcel sending, are performed by nodes themselves in an organizing toward oneself way. Consequently, securing a mobile ad -hoc network is extremely testing.

In order to enhance the specific services within the MANET, MANET supports Qos routing. Qos routing also plays a key role in enhancing network bandwidth.

IV. QOS ROUTING IN MANET

It is very difficult to improve the quality of service in MANETs. It is because of two major reasons:

1. Wireless communication in MANET affects transmitting nodes and receiving nodes [13]. As data packet transmission get affected which will thereby affect the bandwidth and also the receiving property of neighboring links.
2. Broadcastnature of mobile nodes.

Qos routing in MANET has following advantages:

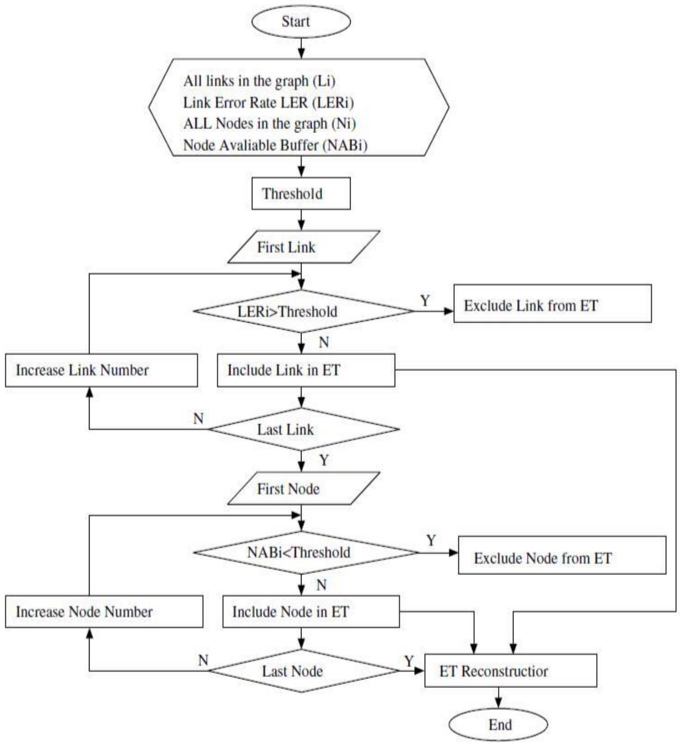
1. Helps in reducing delay during packet transmission between nodes.
2. Network capacity and scalability gets increased.
3. Efficient bandwidth utilization.
4. Most importantly provides the communication security.

V. PROPOSED ALGORITHM

Because of above Qos routing advantages, we proposed an improved Qos routing algorithm for MANETs in the proposed study, called E-GAMAN. E-GAMAN has two algorithms: SSRA and GAMAN:

5.1 SSRA

SSRA is Search Space Reduction Algorithm as given in Figure 1. The key component of SSRA is Effective Topology (ET) extraction. Keeping in mind the end goal to concentrate the ET, the network connectivity information, wireless link and node metrics, and Qos prerequisite of the new connection are needed. We utilize the "Edge" to determine the Qos demand of another solicitation. In the event that the Link Error Rate (LER) is more than the "Edge" or the Node Available Bandwidth (NAB) is short of what the "Limit," this implies that the wireless path which passes by means of this wireless link then again node can't fulfill the prerequisites.



Initially, the SSRA based on the obliged "Limit" weighs all wireless links in the network whether their LER is short of what the "Limit" or not. In the event that the LER is more than the "Edge" then the wireless link is barred from ET. Overall, the wireless link is included in the ET and the following wireless link is checked. The methodology is rehashed until all links are done. Next, the SSRA weighs all nodes in the network, whether their accessible support fulfills the necessities or not. In the event that the NAB is short of what the "Limit" then the node is avoided from the ET. Overall, the node is incorporated in the ET and the following node is checked. The methodology is rehashed until all nodes are done [17]. At last, when its all said and done wireless links and nodes are checked, the network ET is constructed and the complete system is done. By utilizing the SSRA, a network with numerous nodes and wireless links will be lessened in a network with a little number of nodes and wireless links.

5.2 GAMAN

In this study, we might only consider a kind of MANET whose topologies are not changing that quick to make the Qos routing inane. We want to underscore that GAMAN backs delicate Qos without hard guarantees. The delicate Qos implies that there may exist transient time periods when the obliged Qos is not guaranteed because of path breaking or network partition [4]. On the other hand, the obliged Qos ought to be guaranteed when the secured paths remain unbroken. Numerous multimedia applications acknowledge delicate Qos furthermore utilize adaptation methods to diminish the level of Qos disruption. In this version, the GAMAN algorithm utilizes two parameters: deferral and transmission victory rate to choose the Qos path. The proposed algorithm has the accompanying characteristics:

- It is a source-based routing algorithm.

- By utilizing a little population size few nodes are included in course computation.
- By taking a subpopulation, the nodes in this subpopulation think only about the Routes in this subpopulation.
- The broadcast is kept away from in light of the fact that the information is transmitted only for the nodes in a population.
- The GA seek diverse routes and they are sorted by positioning them. So the first is the best course, yet other positioned routes might be utilized as reinforcement routes.
- By utilizing a tree based GA strategy, the circles might be kept away from.
- By utilizing SSRA, the algorithm extricates the viable topology of the MANET by keeping away from transient links and shrouded terminal issues.

Main objective is to register great routes rapidly, and respond to the dynamics of the network quick. As an outcome, GAMAN yields optimality of routes.

The GAMAN algorithm utilizes the Delay Time (DT) and Transmission Success Rate (TSR) Qos parameters. The DT implies the time it takes a parcel to go from one node to another. The TSR shows the rate of effectively transmitted parcels (without misfortune). The quality of T parameter is chosen as takes after.

$$T = \frac{\sum_{i-1}^{n} DT_i}{\prod_{i=1}^{n} TSR_i} \quad (1)$$

Where, n is the amount of wireless links in a path. The GAMAN is a source-based routing component and utilization two Qos parameters for routing. At the point when a node of MANET wants to transmit information to a DN, this node turns into the SN. The network is initially changed in a tree network with the SN as the root of a tree. After that, the tree network is diminished in the parts where the same routes are. The course selection in GAMAN is based on T esteem, which is the proportion of DT with TSR. T is utilized as a wellness function to assess the chose people (routes). By minimizing the T esteem, the DT worth is minimized and the TSR quality is expanded. This implies that a parcel from SN to DN is transmitted with a little defer and a high transmission triumph rate.

VI. Results & Discussion

6.1 SSRA Simulation Result

In order to evaluate the performance of SSRA, we used computer simulations. For simulations we used the following specifications: CPU (Intel Pentium M1.3GHz), Memory (768 MB), OS (Microsoft Windows XP). The program was written in MATLAB. We used a different number of nodes for simulations (20, 30, 40, and 50 nodes). We considered that exist the wireless links in order to make the network topology. Then we put in a random way the values for each wireless link and remaining size of the buffer for each node. For each experiment, we carried out 300 simulations and then got the average values for the different number of nodes.

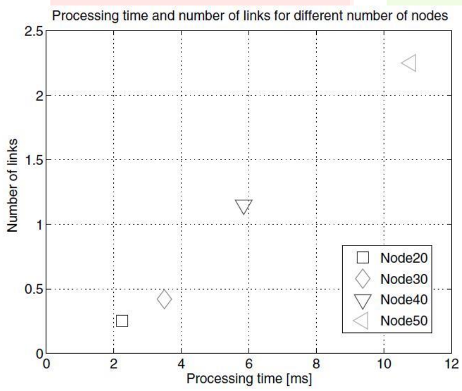


Figure2. Relation between processing time and number of wireless links (Case 1)

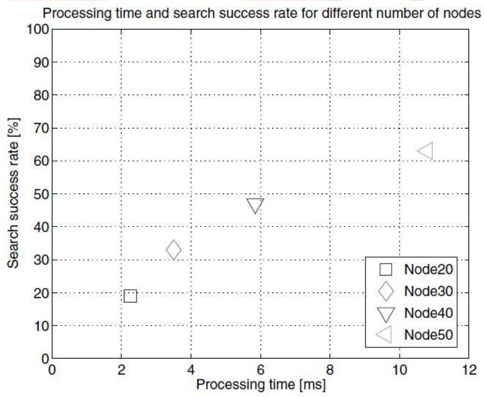
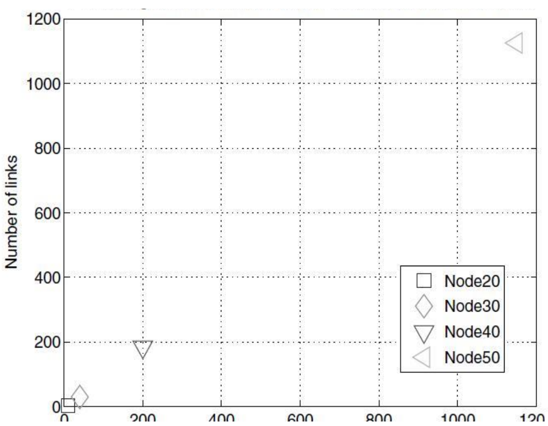


Figure3. Relation between processing time and search success rate



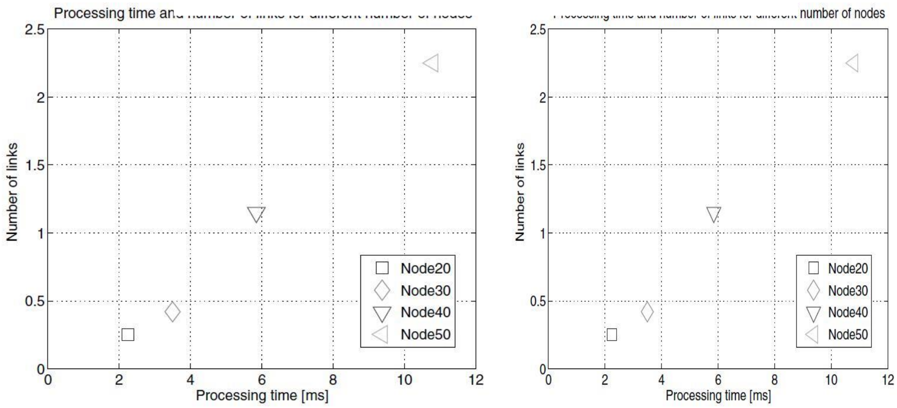


Figure4. Relation between processing time and number of wireless links (Case 2).

In Figure2 is shown the relation between the processing time and the number of wireless links for the different number of nodes. With the increase of the number of nodes, the processing time and the number of the wireless links increased. In Figure3 is shown the relation between the processing time and the search success rate. In this case we put strict threshold, so the success rate was between 20% to 60% for 20, 30, 40, and 50 nodes. In Figure4 and Figure58, we put higher threshold for the wireless link error rate and a small threshold for the buffer remaining capacity. It can be seen in Figure4 that the processing time is faster compared with the processing time in Figure2, while in Figure5 the wireless path searching success ratio is close to 100%.

6.2 GAMAN Simulation Results

By considering that the network topology was reduced by SSRA, we carried out many simulations to evaluate GAMAN for different number of nodes as shown in Figure5 and Figure6.

The performance behavior of GAMAN for a MANET with 20 nodes is shown in Figure7. This Figure shows the rank versus the generation number. The rank is decided based on the value of fitness function T. When the rank is low the fitness value is low. This means that the selected route has a low delay and a high transmission rate.

Nodes	Average	Max	Min
10	4.20	16	*
20	4.80	20	*
30	6.41	30	*
35	10.70	50	*

Figure 5. Time Needed for One Generation (ms).

Nodes	Rank	Gen	Ref
10	2.64	1.00	10.00
20	5.62	8.00	26.30
30	6.44	42.30	80.84
35	5.38	28.72	65.62

Figure 6.Performance for Different Parameters

In Figure5 are shown the simulation results for the time needed for one generation and in Figure6 the performance of GAMAN for different parameters. In Figure6, the Rank, Gen, and Ref have the following meaning.

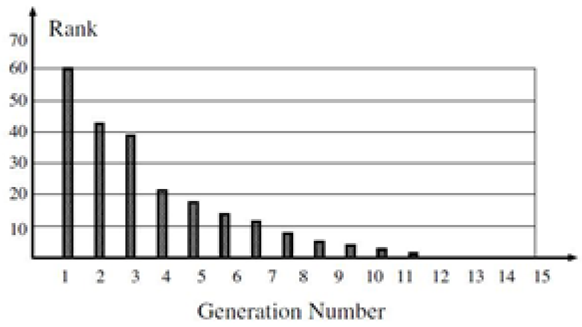


Figure 7.Performance behavior of GAMAN algorithm.

- Rank: the average rank to find a new route.
- Gen: the average number of generations to find a new route.
- Ref: the average number of individuals refereed in one simulation.

The GAMAN can get a new route for about 8 generations for a MANET with 20 nodes. The average time needed for one generation is about 4.8 ms. So, it needs about 40 ms. For a MANET with 10 nodes, it needs about 5 ms, for a MANET with 30 nodes, it needs about 270 ms, and for a MANET with 35 nodes about 300 ms. This shows that GAMAN can support QoS for MANET with 10, 20, 30, and 35 nodes when the network topology changing time is less than 5 ms, 40 ms, 270 ms, and 300 ms, respectively. The execution evaluation by means of simulations shows that the E-GAMAN algorithm has a great execution and is a guaranteeing algorithm for Qos routing in Manets. The proposed GAMAN algorithm could be petitioned little and medium scale networks.

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