Secured-destination Sequenced Distance Vector (SSDV) Routing Protocol for Mobile Ad-hoc Networks

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Abstract– **A mobile ad hoc network (MANET) is a group of wireless mobile nodes dynamically shaping a provisional network devoid of the use of any existing network infrastructure or centralized management. In MANETs, security is the major challenge due to the dynamic topology which is because of the mobility of the nodes. In this paper, we propose a design and develop a secure methodology incorporated with the routing mechanism without having any compromise on the performance metrics viz., throughput, and packet delivery fraction. Not only just improving the throughput and packet delivery fraction it will also reduce the end-to-end delay and MAC overhead along with reduced packet loss. We name it as Secured-destination Sequenced Distance Vector (SSDV) routing. It adopts several features of the already existing protocol named Destination Sequenced Distance Vector Routing (DSDV). The simulation results prove that our proposed protocol SSDV outperforms DSDV in all performance aspects.**

Index Terms– **Routing Protocols, SSDV, Networks, Methodology and Throughput**

I. INTRODUCTION

THE alluring infrastructure-less phenomenon of mobile ad hoc networks (MANETs) has received more attention in the research society. With the success of solving the most fundamental but vital issues in all network layers, persons understand there is commercial value in MANETs. The most of the applications that draw attention for utilizing in current wired networks (e.g., video conferencing, on-line live movies, and instant messenger with camera enabled) would attract interest for MANETs. Though, MANETs present distinctive advanced challenges, including the design of protocols for mobility management, effective routing, data transportation, security, power managing, and quality-of-service (QoS). Once these issues are resolved, the use of MANETs will be attainable. Nowadays applications heavily demand the fulfilment of their Quality of Service (QoS) requirements, which in this distributed and particular environment can be difficult to solve. This scenario requires specific proposals adapted to the new problem statements [1,2,3]. Trying to solve all these problems and coming out with a single solution would be too complex. To offer bandwidth-guaranteed QoS, the available end-to-end bandwidth along a route from the source to the destination must be known. The end-to-end throughput is a concave parameter [6], which is determined by the bottleneck bandwidth of the intermediate hosts in the

route. A survey of several routing protocols and their performance comparisons have been reported in [7]. Hence in this paper, we focus on providing security along with QoS in MANETs.

In order to design good protocols for MANETs, it is important to understand the fundamental properties of these networks.

Dynamicity: Every node in the mobile ad hoc network will change its position on its own. Hence prediction of the topology is difficult, and the network status is not clear and it is vague.

Non-centralization: There is no existence of centralized control in mobile ad hoc network and, hence assigning resources to MANET in advance is not possible.

Radio properties: The medium is wireless, hence results in fading, multipath effects, time variation, etc. With these complications, Hard QoS is not easy to achieve.

II. RELATED WORKS

In [4] Zhao et al have reviewed the existing approaches of available bandwidth estimation. They presented the efforts and challenges in estimation of bandwidth. Also, they proposed a model for finding available bandwidth with improved accuracy of sensing based bandwidth estimation as well as prediction of available bandwidth.

In [5] Gui et al have defined routing optimality with the usage of different metrics like path length, energy consumption and energy aware load balancing within the hosts. Along with they have proposed a methodology for self-healing and optimizing routing (SHORT) technique for MANET. SHORT increases performance with regard to bandwidth and latency. They classified SHORT into two categories such as Path-Aware SHORT and Energy-Aware SHORT.

The QAMNet [8] approach extends existing ODMRP routing by introducing traffic prioritization, distributed resource probing and admission control mechanisms to provide QoS multicasting. For available bandwidth estimation, it used the same method given in SWAN [9] where the threshold rate for real-time flows is computed and the available bandwidth estimated as the deference between the threshold rate of real-time traffic and the current rate of real-time traffic. It is very difficult to estimate the threshold rate accurately because the threshold rate may change dynamically depending on traffic pattern [9]. The value of threshold rate should be chosen in a sensible way: Choosing a value that is too high results in a poor performance of real-

time flows, and choosing a value that is too low results in the denial of real-time flows for which the available resource would have sufficed.

The localization methods are also distinguished by their form of computation, "centralized" or "decentralized". For example, MDS-MAP [13] is a centralized localization that calculates the relative positions of all the nodes based on connectivity information by Multidimensional Scaling (MDS). Similarly, DWMDS (Dynamic Weighted MDS) [10] uses movement constraints in addition to the connectivity information, and estimates the trajectories of mobile nodes. TRACKIE [12] first estimates mobile nodes that were likely to move between landmarks straight. Based on their estimated trajectories, it estimates the trajectories of the other nodes. Since these centralized algorithms use all the information about connectivity between nodes and compute the trajectories off-line, the estimation accuracy is usually better than decentralized methods.

In decentralized methods, the position of each node is computed by the node itself or cooperation with the other nodes. For example, APIT [15] assumes a set of triangles formed by landmarks, checks whether a node is located inside or outside of each triangle, and estimates its location. Amorphous [11] and REP [16] assume that location information is sent through multi-hop relay from landmarks, and each node estimates its positions based on hop counts from landmarks. In particular, REP first detects holes in an isotropic sensor network, and then estimates the distance between nodes accurately considering the holes. In MCL [6], each mobile node manages its Area of Presence (AoP) and refines its AoP whenever it encounters a landmark. In UPL [14], each mobile node estimates its AoP accurately based on AoP received from its neighboring nodes and obstacle information.

III. PROPOSED WORK

In order to implement QoS, we propose to develop a protocol which guarantees QoS along with secure destination sequenced distance vector routing. In all the available existing protocols with regard to security, QoS requirements were compromised. We aim to develop a security enriched protocol which does not compromise with QoS requirements. For achieving the above goal we design a framework which uses estimation of 'data transfer rate', estimation of 'residual energy', 'threshold value'.

A. Bandwidth Estimation

The bandwidth can be estimated as follows:

Packet Delivery Time $(Ø_d) = Ø_r - Ø_s$

Where $Ø_r$ is Packet Received Time, $Ø_s$ is Packet Sent Time.

Bandwidth= $D_S / Ø_d$ $\rightarrow$ (1)

Where D_S is Data Size.
Bandwidth is the ratio between Size of the Data and Actual Time taken to deliver the packet.

In following two cases bandwidth gets reduced:

1) When there is more channel contention i.e., Channel sensing busy due to more Request to Send (RTS) / Clear to Send (CTS), collisions and higher back-offs;

2) When there are more channel errors i.e., error bits in RTS/DATA which causes RTS/DATA retransmission.

B. Residual Energy

The Residual Energy [17] is calculated as follows:

$$RE_{node} = IE_{node} - CE_{node} \rightarrow 2$$

Where IE_{node} is the Initial Energy of the node and CE_{node} is the Consumed Energy of the node. The residual energy of a node is the difference between initial energy and consumed energy.

C. SSDV Routing

Secured-destination Sequenced Distance Vector (SSDV) is a proactive secured routing protocol. It gains some of the inherent qualities of the distance vector algorithm. In such kind of proactive routing protocols, each node repeatedly maintains state-of-the-art routes to every other node in the network. Routing information at regular intervals transmitted throughout the network in order to preserve routing table stability. When the route discovery process is initiated, the two state-of-the art estimations such as bandwidth and residual energy will be calculated using (1) and (2). That information is mainly used to determine the path from the source node to the destination node. The routing table is updated at every node by discovering the variation in routing knowledge about all the existing destinations with the number of nodes to the destination. When the attacker tries to impersonate as intermediate node our SSDV protocol will recognize the intruder using *Intruder Detection Methodology,* and redirect the path to the destination. In addition, to offer loop freedom our protocol SSDV uses succession count, which is offered, by the destination node. However, when a route has already existed before traffic arrives, transmission takes place without any delay. Else, traffic packets must wait in queue till the node gets routing information equivalent to its destination. In case of highly dynamic network topology, the proactive schemes need a noteworthy quantity of resources to maintain routing information up-to-date and reliable. Further AES algorithm is used to encrypt the data to provide security.

D. Intruder Detection Methodology (IDM)

After calculating the path in which packets are to be routed, the source node will forward certain number packets to the next hop (node). The number of packets thus sent to the first hop will be set as threshold value. Thus obtained threshold value will be verified at every node in the path before despatching the packets. And if any of the nodes in the path has got different value other than that of threshold value then they are treated as Intruder and the path is rediscovered with the new threshold value and discarding the intruder node. Once again the above process is repeated till such time it reaches the destination node.

When the non-availability of a route to the next node, the node instantly updates the succession count and broadcasts the knowledge to its neighbors. When a node gets routing knowledge then it verifies in its routing table. If it does not have such entry into the routing table then updates the routing table with routing information it has obtained. If the node finds that it has already had an entry into its routing table then it compares the succession count of the received information with the routing table entry and updates the

information. If it has succession count that is less than that of the received one then it rejects the information with the least succession count. Suppose both the succession counts are one and the same then the node keeps the information that has the shortest route or the least number of hops to that destination.

IV. PERFORMANCE METRICS

Average End-to-End Delay: The end-to-end-delay is averaged over all surviving data packets from the sources to the destinations.

Average Packet Delivery Ratio: It is the ratio of the number of packets received successfully and the total number of packets sent.

Throughput: It is the number of packets received successfully.

Drop: It is the number of packets dropped.

V. RESULTS AND DISCUSSIONS

Fig. 1 gives the throughput of both the protocols when the pause time is increased. As we can see from the figure, the throughput is more in the case of SSDV than DSDV. Fig. 2 presents the packet delivery ratio of both the protocols. Since the packet drop is less and the throughput is more, SSDV achieves good delivery ratio, compared to DSDV. From Fig. 3, we can ensure that the packets dropped are less for SSDV when compared to DSDV. From Fig. 4, we can see that the average end-to-end delay of the proposed SSDV protocol is less when compared to the DSDV protocol.

VI. CONCLUSION AND FUTURE WORKS

In this paper we designed and developed a destination sequenced routing named Secured-destination Sequenced Distance Vector (SSDV) routing protocol which meets the requirements of QoS such as improved throughput with better packet delivery ratio and reduced end-to-end delay and reduced no of drop in packets. Additionally, we provide a secure route maintenance mechanism by involving threshold in terms of packets. Further we provided security in terms of Advanced Encryption Standard (AES) algorithm using add-round key for data security while transmission of data. The results graph using the performance metrics outperformed when compared with Destination Sequenced Distance Vector (DSDV) routing protocol. The framework used in this research would be further incorporated with other distance vector protocols. MANET routing protocols can be probed for incorporating security mechanism without compromising QoS.   Introduction of security mechanism in routing protocol normally reduces the QoS. Author has successfully overcome the problem and obtained a better QoS for security enable routing protocols in MANET.
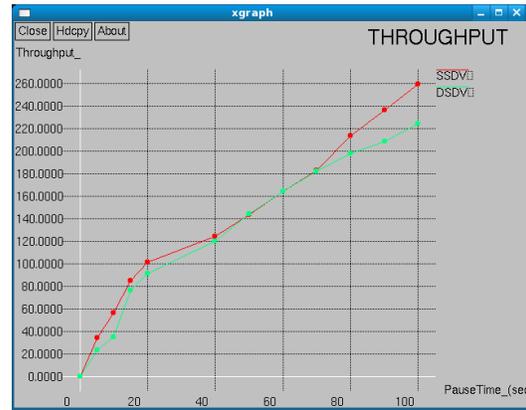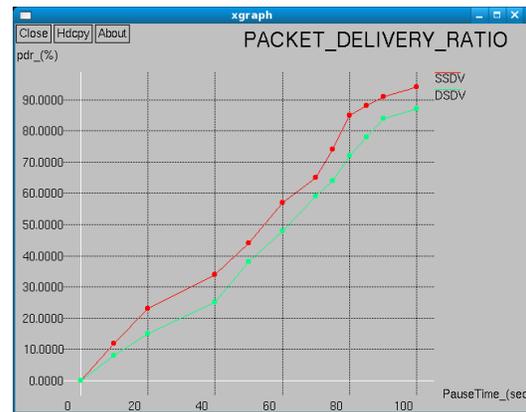

Fig. 1. Pause-Time Vs Throughput
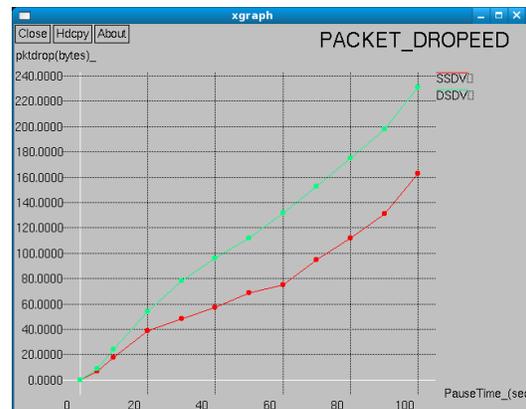

Fig. 2. Pause-Time Vs Packet Delivery Ratio

Fig. 3. Pause-Time Vs Packets Dropped

Fig. 4. Pause-Time Vs End-to-End Delay

REFERENCES

[1] Chakrabarti S & Mishr A, "QoS issues in ad hoc wireless networks", IEEE Communications Magazine, Vol.39 No.2, pp.142–148, 2001.

[2] Mohapatra & Gui C, "QoS in mobile ad hoc networks", IEEE Wireless Communications, Vol. 10 No. 3, pp. 44–52, 2003.

[3] Reddy T.B, Karthigeyan I, Manoj B. S, & Siva Ram Murthy C, "Quality of service provisioning in ad hoc wireless networks: A survey of issues and solutions", Ad hoc Networks, Vol. 4 No. 1, pp. 83–124, 2006.

[4] Haitao Zhao, Jibo Wei, Shan Wang and Yong Xi, "Available Bandwidth Estimation and Prediction in Ad hoc Networks", Wireless Networks, Vol.14, pp. 29–46, 2008.

[5] Chao Gui & Mohapatra, "A Framework for Self-healing and Optimizing Routing Techniques for Mobile Ad hoc Networks", Wireless Networks, Vol.14 No.1, pp.29-46, 2008.

[6] P. Mohapatra, J. Li, and C. Gui, "QoS in mobile ad hoc networks," IEEE Wireless Commun. Mag. (Special Issue on QoS in Next-Generation Wireless Multimedia Communications Systems), pp. 44–52, 2003.

[7] E.M. Royer and C.-K. Toh, "'A review of current routing protocols for ad hoc mobile wireless networks," in: IEEE Personal Communications, April 1999.

[8] H. Tebbe, and A. Kassler, "QAMNet: Providing Quality of Service to Ad-hoc Multicast Enabled Networks", 1st International Symposium on Wireless Pervasive Computing (ISWPC), Thailand, 2006.

[9] G. S. Ahn, A. T. Campbell, A. Veres and L.H. Sun, "SWAN: Service Differentiation in Stateless Wireless Ad hoc Networks", In Proc. IEEE INFOCOM, 2002.

[10] J. M. Cabero, F. D. la Torre, A. Sanchez, and I. Arizaga. Indoor people tracking based on dynamic weighted multidimensional scaling. In Proc. of MSWiM 2007, pages 328–335, 2007.

[11] R. Nagpal, H. Shrobe, and J. Bachrach. Organizing a global coordinate system from local information on an ad hoc sensor network. In Proc. of IPSN 2003, pages 333–348, 2003.

[12] S. Fujii, A. Uchiyama, T. Umedu, H. Yamaguchi, and T. Higashino. An off-line algorithm to estimate trajectories of mobile nodes using ad-hoc communication. In Proc. of PerCom 2008, pages 117–124, 2008.

[13] Y. Shang, W. Rml, Y. Zhang, and M. Fromherz. Localization from connectivity in sensor networks. IEEE Transaction on Parallel and Distributed Systems, 15(11):961–974, 2004.

[14] A. Uchiyama, S. Fujii, K. Maeda, T. Umedu, H. Yamaguchi, and T. Higashino. Ad-hoc localization in urban district. In Proc. of INFOCOM 2007 Mini-Symposium, pages 2306–2310, 2007.

[15] T. He, C. Huang, B. M. Blum, J. A. Stankovic, and T. Abdelzaher. Range-free localization schemes for large scale sensor networks. In Proc. of MobiCom 2003, pages 81–95, 2003.

[16] M. Li and Y. Liu. Rendered path: range-free localization in anisotropic sensor networks with holes. In Proc. of MobiCom 2007, pages 51–62, 2007.

[17] S. Santhosh Baboo, B. Narasimhan, "An Energy-Efficient Congestion-Aware Routing Protocol for Heterogeneous Mobile Ad Hoc Networks," act, pp.344-350, 2009 International Conference on Advances in Computing, Control, and Telecommunication Technologies, 2009.

Lt. Dr. S. Santhosh Baboo, aged forty, has around Seventeen years of postgraduate teaching experience in Computer Science, which includes Six years of administrative experience. He is a member, board of studies, in several autonomous colleges, and designs the curriculum of undergraduate and postgraduate programmes. He is a consultant for starting new courses, setting up computer labs, and recruiting lecturers for many colleges. Equipped with a Masters degree in Computer Science and a Doctorate in Computer Science, he is a visiting faculty to IT companies. He has been keenly involved in organizing training programmes for students and faculty members. His good rapport with the IT companies has been instrumental in on/off campus interviews, and has helped the post graduate students to get real time projects. He has also guided many such live projects. Lt. Dr. Santhosh Baboo has authored a commendable number of research papers in international/ national Conference/ journals and also guides research scholars in Computer Science. Currently he is Reader in the Postgraduate and Research department of Computer Applications at Dwaraka Doss Goverdhan Doss Vaishnav College (accredited at 'A' grade by NAAC), one of the premier institutions in Chennai.

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