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Mobility Assisted Uncertainty Reduction in MANETS Using Forward Node Optimization

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Abstract

A mobility-assisted scheme called efficient flooding scheme is provided to achieve the high probability of trust convergence. Trust will be defined as the belief in the capability of an entity (node) to proceed reliably, securely and dependably within a specified context. It represents a MANET participant's hope of other nodes' behavior while assessing the risk involved in future interactions. Here, the participant, called the trustor, and other nodes are said to be trustee. The trust relationship usually builds on the basis of the trust or's past direct interaction experiences and others' recommendations related to the trustee. The abstracted value from precedent experiences and from recommendations is defined as the trustee's reputation. The proposed mobility assisted scheme, an efficient flooding scheme which is based on node's mobility. The efficient flooding scheme is based on one-hop neighbor that leads to reduction of number of forwarding nodes. This scheme offers a handy tradeoff between delay, cost, packet delivery and trust ratio which leads to uncertainty reduction.

Keywords: Flooding; Mobile ad hoc Networks; Node forwarding; Trust Covergence; Uncertainty reduction.

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1. Introduction

Mobile Ad Hoc Networks able to communicate using a wireless medium without having to choice to a preexisting network infrastructure. A fundamental characteristic of ad hoc networks is that they can configure themselves on-the-fly without the participation of a centralized administrator. Since MANET is a self configuring and autonomous communication system that uses node to node hops to transmit data from one node to another. In MANET, traffic which was not terminated by a node is forwarded by that node to rest of the nodes within range and a node which helps in forwarding may therefore act as a simple router.

Uncertainty refers to the degree to which a node that cannot accurately predict the behavior of its communal rival [1]. Uncertainty arises from information asymmetry and opportunism. One way to efficiently reduce the uncertainty is to exploit the key aspect of MANETs: mobility. The movement of node can increase the scope of direction and recommendation propagation and thereby pace up trust convergence. The proposed scheme called efficient flooding scheme helps in exploiting the mobility.

Flooding is one of the most primary operations in mobile ad hoc networks (MANET). Most of the key routing protocols like Dynamic Source Routing, ZRP and AODV rely on flooding for route discovery dissemination, route upholding and topology update. Flooding is a very recurrently invoked efficacy function in MANETs. Therefore, an efficient play of flooding scheme is very important in order to limit the overhead of routing protocols and to enhance the throughput of networks. Flooding scheme needs that every node to keep only 1-hop neighbor information. An efficient implementation flooding schemes reduce the overhead of routing protocols and improving the throughput of the network. The efficient flooding scheme varies from the broadcast mechanisms.

2. Related Work

2.1 Trust Evaluation

Uncertainty is evaluated in terms of trust convergence and high authentication probability. Different mobility schemes like metropolis, hierarchical are implemented. Existing reputation systems leaves gives space for elaborate attackers for launching false accusation attacks since there is no restriction on update frequency. This approach has also not able to separate newcomers from misbehavers. Josang [7] introduced algebra for determining trust relations, where a triplet designating uncertainty, belief and disbelief are assigned to each trust declaration. However, its primary weakness is that the opinion of every entity is based on its own slanted policy and the system cannot assure that users will have consistent values. It also lacks hand to fuse different recommendations. Carbone et al. proposed a formal trust structure in [14].

2.2. Reputation System

Reputation and Trust-based Monitoring Systems (RTMSs) has provided an ideal framework for securing Wireless Sensor Network (WSN). In the existing RTMSs, typically each node is provided with a *watchdog* which operates in a promiscuous mode for acquiring information about neighbouring node's behaviour. Sensors are very highly resource (energy)-constrained and their autonomous operation in unreceptive territories renders them exposed to physical node capture attacks. So the resource-constrained sensors should be used only for demanding services so that the network lifetime can be extended.

2.3. Flooding Scheme

Flooding is one of the most basic and vital operations in mobile ad hoc networks. Traditional approaches of flooding suffer from the problems of excessive message redundancy, resource contention, and signal collision. This causes a high protocol overhead and interfering with the existing traffic in the networks. Many flooding schemes were proposed to avoid these problems. However, those schemes either perform poorly in reducing transmission redundancy or to maintain 2-hop (or more) neighbours information of every node. So, an efficient implementation of flooding scheme is in demand for the reduction of routing protocols overhead and enhancing the throughput of networks. The existing flooding schemes are classified based on the information each node keeps: 1) nil neighbour information, 2) one-hop neighbour information, and 3) two-hop or more neighbour information. Schemes which lie under (1) are not in need of information on neighbours. A pure flooding scheme is a typical example in this category.

3. Proposed System

3.1. Proposed System for efficient flooding scheme

The functional architecture of proposed system is shown in figure 1. A fully distributed reputation system which can cope up with false disseminated information where the random mobility models are going to be used that can determine optimal path in terms of route availability and route stability. The efficient flooding scheme is going to be used which leads speed-up *trust convergence* and *high authentication* probability respectively by reducing uncertainty.

Fig.1. Functional Architecture of proposed system

3.1.1. Functionalities

The trust opinion has to be gathered from first hand information and second hand information. The Second hand information leads recommendation calculation from different nodes. All these recommendations have to be synthesized. While synthesizing, the false accusation and dales praise has to be removed. An opinion combination has to be generated from computed uncertainty and synthesized recommendation. This leads abstract value to the reputation system.

3.1.2. Efficient Flooding Scheme

Flooding is one of the most basic and vital operations in mobile ad hoc networks. Conventional implementation of flooding has the problems of excessive redundant messages, resource contention, and signal collision. This causes high protocol overhead and intrusion to the existing traffic. The existing flooding schemes are unsatisfactory either in reducing transmission redundancy or require each node to maintain two-hop (or more) neighbours information. The vital and necessary condition of 100% deliverability for flooding schemes is based on only one-hop neighbour's information. Figure 2 shows the working of an efficient flooding algorithm that can achieve the optimality in two wits: 1) the number of forwarding nodes in each step should be minimized, 2) the time complexity for forwarding nodes computation should be low, which is ***O* (*nlogn*)**, where *n* denotes the number of neighbours of a node.

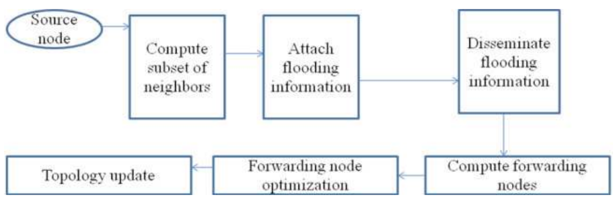

Fig. 2. Working of Efficient flooding scheme

The main objective of the efficient flooding scheme is to reduce the number of forwarding nodes as much as possible, such that the redundant packet transmission is minimized. So the metric *ratio of forwarding nodes* to evaluate the efficiency of flooding schemes is used. The ratio of forwarding nodes is defined as the ratio of total number of nodes involved in the packet forwarding in a flooding operation to the total number of nodes that are in the network.

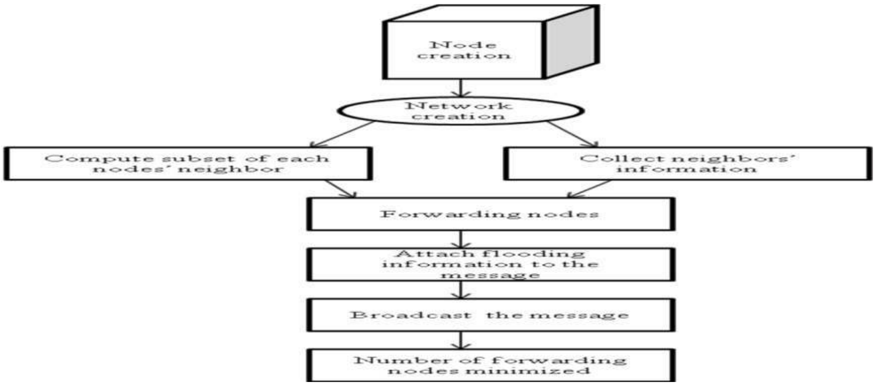

Fig.3. Minimization of forwarding nodes through flooding scheme

3.1.3. Functional architecture of efficient Flooding Scheme

The source node will compute the subset of neighbours. The flooding information will be attached to each of the neighbours and the neighbours will disseminate the flooding information to all other intermediate nodes. From this the forwarding nodes will be computed. From the forwarding nodes, node optimization will be done. The topology will be updated based on the node's mobility.

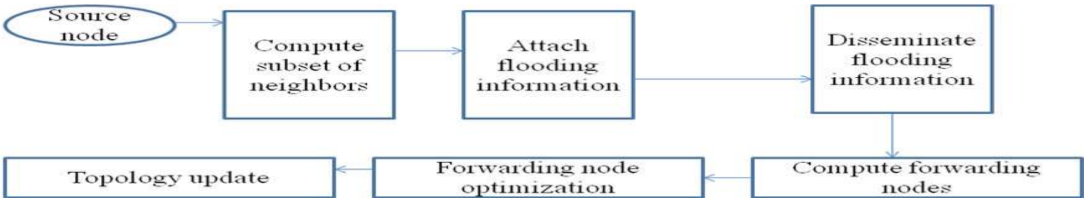

Fig 4. Functional Architecture for flooding scheme

3.1.4. Mobility handling

In MANETs, nodes can be mobile, which leads to dynamic changes of the network topology. In the flooding scheme, each node, say *n*, maintains its neighbour information and computes $F(n)$. To handle with the dynamic change in topology, two strategies are needed in the flooding scheme: a) No update. Every node re-computes its forwarding node set for that node's flooding request; or b) update which should be incremented every time. Each node update its forwarding node set incrementally upon change of each topology change. For strategy (a), we do not need to do anything.

4. Experimental Results and Performance Analysis

4.1. Efficient Flooding Scheme

The Figure 5 shows the average delay, number of trust packets sent, trust packets received and total number of uncertain packets for flooding scheme. In this, the number of uncertain packets has been reduced and the packet delivery ratio has been increased is shown.

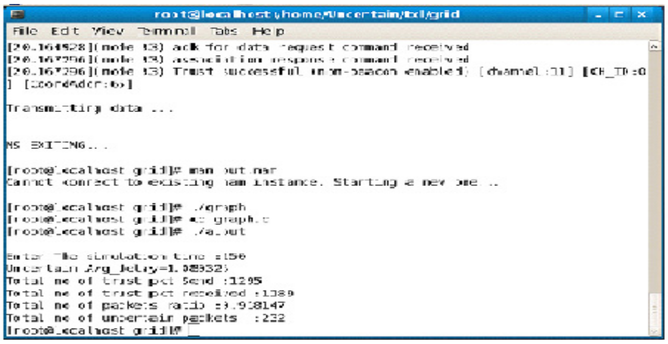

Fig.5. Output terminal for Flooding Scheme

4.2. Performance Analysis

The analysis has been done in order to show the uncertainty reduction for two different schemes. The uncertainty reduction is shown in terms of delay, number of packets sent, number of packets lost and trust ratio. The data are taken from trace files for various simulation times.

4.2.1. Time Vs Delay

Delay can be defined as the time taken to collect trust opinions since uncertain nodes exists in the reputation system. The x-axis is taken for time in ms and y-axis is meant for delay. By implementing the efficient flooding scheme the delay is reduced when compared to hierarchical scheme.

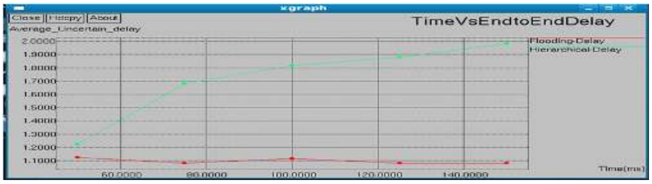

Fig.6. Time Vs Delay

4.2.2. Time Vs Packet loss

Packet delivery ratio= (no. of packets received) / (total no. of packets sent). The x-axis is meant for time and y-axis is for packets. The packet loss has been reduced when compared to the existing system.

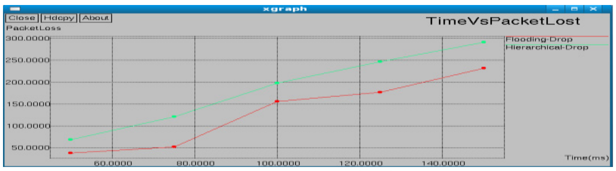

Fig.7. Time Vs Packet loss

4.2.3. Time Vs Trust Ratio

Trust can be defined as the firm belief in the competence of an entity to act securely reliably and independently within a specified context (Fig 8). The x-axis is meant for time and y-axis is for trust ratio.

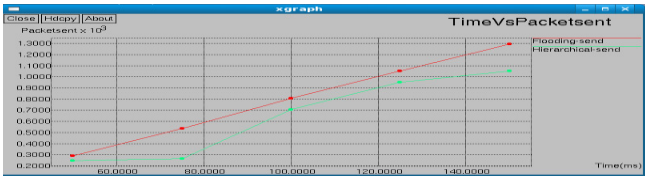

Fig.8. Time Vs Trust ratio

4.2.4. Time Vs Packet sent

The packet consists of trust opinions about various nodes. The x-axis is meant for time and y-axis is for packets. The number of packets sent is more while using proposed system

Fig.9. Time Vs Packet sent

Conclusion

The Efficient flooding scheme uses only one-hop neighbour information and it is proved that efficient flooding scheme gains the optimality in terms: 1) number of forwarding nodes should be minimized and 2) the time complexity O (*nlogn*) should be low. The energy efficient scheme can decrease packet drops and improves reliability. The life time of the network and each node is increased by selecting more reliable node as a router. Extensive simulations are conducted to compare our scheme with hierarchical scheme. Simulation results have shown that the proposed scheme uses incurs less collision, less number of forwarding nodes and obtains improved deliverability ratio compared with the existing schemes. Through the implementation of forwarding node minimization, uncertainty can be reduced which leads to the improvement of network lifetime.

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