Integration of Co Operation Incentives in Mobile Ad Hoc Network

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Abstract--- In mobile ad hoc networks (MANETs), tasks are conducted based on the cooperation of nodes in the networks. However, since the nodes are usually constrained by limited computation resources, selfish nodes may refuse to be cooperative. Reputation systems and price-based systems are two main solutions to the node non co-operation problem. A reputation system evaluates node behaviours by reputation values and uses a reputation threshold to distinguish trustworthy nodes and untrustworthy nodes. A price-based system uses virtual cash to control the transactions of a packet forwarding service. Although these two kinds of systems have been widely used, very little research has been devoted to investigating the effectiveness of the node cooperation incentives provided by the systems. In this project, we use game theory to analyze the cooperation incentives provided by these two systems and by a system with no cooperation incentive strategy. We find that the strategies of using a threshold to determine the trustworthiness of a node in the reputation system and of rewarding cooperative nodes in the price-based system may be manipulated by clever or wealthy but selfish nodes. We further enhance the system by addressing the security issues of cooperative nodes. This provides security by encrypting the packet in sender and then it forwards to the intermediate node. And the packets are decrypted by the receiver node. Obviously the packets are not lost during data transmission.

I. Introduction

The goal of game theory is to evaluate each node's trustworthiness based on its behaviours and detect misbehaving nodes according to Reputation systems and Price based system to distinguish between misbehaving nodes and cooperative nodes. By integrating the systems, the reputation values and the incentives are increased for the co-operative nodes. A mobile ad hoc network (MANET) is a distributed network. In a MANET, because of the short transmission range, a packet is forwarded in a multi hop fashion to its destination relying on the nodes in the routing path. Thus, MANETs require the cooperation of every node in the path for successful packet transmission. Since nodes in MANETs are usually constrained by limited power and computational resources such as CPUs or batteries, the nodes may not be willing to be cooperative so as to save their limited resources. It has been proved that the presence of only a few selfish nodes can dramatically degrade the performance of an entire system. Additionally, identifying and punishing selfish nodes will decrease the throughput of cooperative nodes and lead to complete network disconnection. Therefore, encouraging nodes to be cooperative and detecting selfish nodes in packet transmission is critical to ensuring the proper functionalities of MANETs

II. Related Works

Reputation systems and price-based systems are two main approaches proposed to encourage cooperation between mobile nodes in MANETs. A reputation system gathers observations of node behaviors and calculates node reputation values [7], [8]. The system detects and punishes low-reputed nodes by isolating them from the MANETs. There are two types of reputation systems: first- hand based and second-hand based. In the first-hand-based reputation system [9], [10] a node only believes its own observations about other nodes' behaviors, and the exchanges of reputation information between nodes are disallowed. Balakrishnan et al. [7] and Dewan et al. [8] let the source node choose the next hop node with sufficiently high reputation during the packet routing in order to achieve routing reliability. OCEAN [9] avoids indirect (second hand) reputation information and uses only direct (first hand) observations in order to see the performance of this method. Liu et al. [10] proposed to expand the scope of the behavior observation from one hop to two hops. In the second-hand reputation systems [11], [15], [16], [18], nodes share observations of node behaviors by periodically exchanging observed information. In Core [11], Confident [12] and the work in [13], a node promiscuously listens to the transmission of the next node in the path to detect misbehaviour, and aggressively informs other nodes of the misbehaviours by reporting around the network to isolate the misbehaving nodes.. Although observation sharing has some potential drawbacks such as increased transmission overhead, misreporting and collusion, it can detect node misbehaviour faster than the first-hand-based reputation systems.

Although these reputation systems use linear [13], [14] or nonlinear reputation adjustment mechanisms [16], [18] for reputation calculation, they still use a threshold to distinguish selfish nodes from cooperative nodes. Thus, clever selfish nodes can wisely maintain their reputation value just above the threshold by selectively forwarding others' packets regard- less of the reputation calculation mechanism. Such nodes can take advantage of other cooperative nodes without being detected. Also, these methods cannot reward high- reputed nodes differently or punish low-reputed nodes in different reputation levels. Price-based systems. In the price-based systems, nodes are paid for offering packet forwarding service and pay for receiving forwarding service

III. Proposed Method

To overcome the drawbacks in each system, we propose and analyze the systems through game theory. Game theory is a branch of applied mathematics that models and analyzes interactive decision situations called games. Game theory models can be classified into cooperative game models and non-cooperative game models. We use a cooperative game to explore ways to form a rational coalition that can optimize the benefit of each node.

This game to investigate the best strategy for each node to maximize its benefit and find that the cooperation incentives provided by both reputation systems and price-based systems. Specifically, the reputation systems treat nodes whose reputation values are higher than the threshold. Equally Thus, a node can keep its reputation value just above the threshold to receive the same benefit as the nodes with much higher reputations. So this the nodes cooperates to receive the incentives.

– Selfish nodes are detected; co-operative nodes are encouraged by providing reputation values and incentives.
– Degradation of the system is prevented. Reputation values and credits make the nodes to co-operate. Performance increased because of cooperative node.
– The game theory model for MANETs is denoted as follows: Given a normal form of game G, G=<N, D, ui (a_i, a_{-i}).

IV. MODULES DESCRIPTION

A. *Network Setup*

In this module, we are going to set up network for co-operative game. A mobile ad hoc network consists of a group of nodes that communicate without requiring a fixed wireless infrastructure. Each system conventionally employs multiple hops between the nodes. This network is a distributed network without any central control. And in this all the nodes are created in a distributed manner for the packet transfer between nodes in the network. And sender node and the destination nodes are chosen and in between nodes are assigned as the intermediate nodes. Each source node chooses a particular routing path to forward its data to destination and the intermediates node are selected to transfer the packet from source to destination or to the next intermediate node Each packet in are forwarded in a Multi hop fashion to its destination relying on the nodes in the routing path. By this multi hop fashion; communication between two nodes is carried out through a number of intermediate nodes whose function is to relay information from one point to another.

B. *Nodes and Packet Selection*

In this module, we going to select the source node and the destination node from the nodes distributed. The source node selects the available route to transfer its data to the destination. And source node selects a particular packet and forwards the packet to destination in the selected available route through the intermediate nodes. Each packet consists of two kinds of data: control information and user data. The control information provides data the network needs to deliver the user data, for example: source and the destination addresses to which it need to forward. The source node selects the intermediate node only in order to reduce the packet drop rate by the reputation value and the threshold value.

C. *Reputation Value, Threshold Value Assignment*

In this module, we are going to select the available paths for packet forwarding. In each available path intermediate nodes are assigned as a cooperative node or selfish node. And the source node selects the intermediate node only if is a cooperative node based on its reputed value and the threshold value. The reputation systems are to evaluate each node's trustworthiness based on its behaviours and detect misbehaving nodes according to reputation values. Reputation systems enable each node to maintain a reputation table recording the reputation values of other nodes. Most reputation systems set up a reputation threshold to distinguish between misbehaving nodes and cooperative nodes. Nodes whose reputation values are higher than the threshold are regarded as cooperative nodes; otherwise, the nodes are regarded as selfish nodes. During packet routings, a node selects cooperative nodes as relay node and avoids selfish nodes. And the source node monitors the packet transmission of the intermediate nodes. During packet routings, a node selects cooperative nodes as relay node and avoids selfish nodes. And the source node monitors the packet transmission of the intermediate nodes.

D. *Monitoring Process*

In this module, we are going to monitor the packet transmission of the intermediate nodes by the monitor agent. This monitoring is to provide higher node cooperation incentives; the integrated system can also effectively detect selfish nodes by monitoring node reputation and account value. By this monitoring process the states of the nodes can be predicted and all the detail is found by the system. The monitoring performance of the integrated system is to detect wealthy and silly selfish nodes, and wealthy and clever selfish nodes. The monitor agent records all the transmission of the intermediate nodes in its table. This table contains the information of the nodes whether the nodes are selfish or cooperative node.

E. *Addition of Reputation Value and Credits*

In this module, we are going to provide reputation value and credits for the intermediate nodes for the successful packet transmission by the integrated system. A system that can effectively encourage the cooperation of nodes should have two features: 1) increasing the reputation value for the intermediate node and effectively detection of selfish nodes for punishment.2. Providing credits to the intermediate nodes .The reputation system provides the reputation value to the intermediate node to the cooperative nodes for successful packet transmission. However, it cannot provide strong incentives for cooperation. The price-based systems can provide strong incentives for node cooperation, for cooperation. And these reputation value and the credits are provided by the source node based on the details of the monitoring process.

1) *Reputation System*

A reputation system gathers observations of node behaviors and calculates node reputation values. The system detects and punishes low-reputed nodes by isolating them from the MANETs.

2) *Price based System*

In the price-based systems, nodes are paid for offering packet forwarding service and pay for receiving forwarding service. This is predict the cheating behavior of the nodes such as requiring credits for fake service requests and denying service after receiving credits in the price system.

F. Future Enhancement

Further enhance the system by addressing the security issues of cooperative nodes. For this problem we propose the design and performance evaluation of a new secure on-demand in the ad hoc network routing protocol, called Ariadne. Generally the attackers may compromise the nodes to obtain the packets from the intermediate node. So Arianne provides security by encrypting the packet in sender and then it forwards to the intermediate node. And the packets are decrypted by the receiver node. Obviously the packets are not lost during data transmission.

V. OUTPUT ANALYSIS

A. Nodes Creation

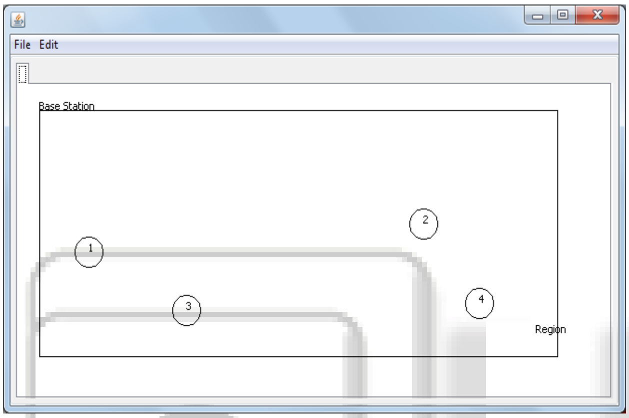


Fig. 1: nodes creation

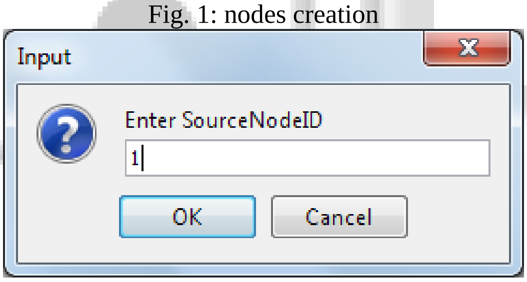


Fig. 2: source node

B. Node1 request

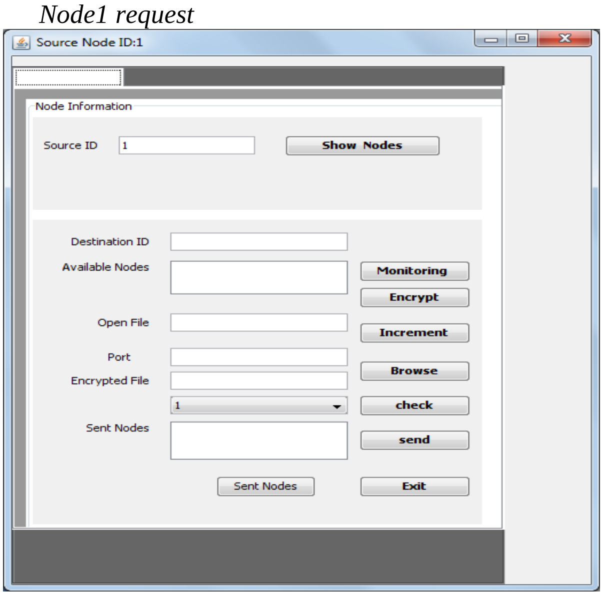
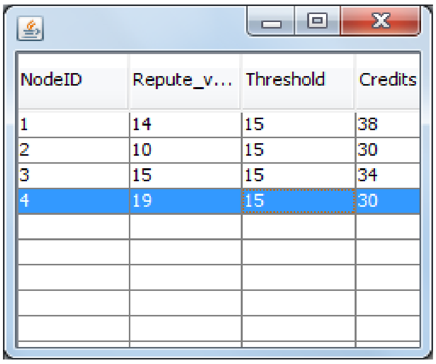


Fig. 3: node1

C. Reputation values, credits for node



NodeID	Repute_v...	Threshold	Credits
1	14	15	38
2	10	15	30
3	15	15	34
4	19	15	30

Fig. 4: Reputation values, credits for nodes

D. Node1 sending process

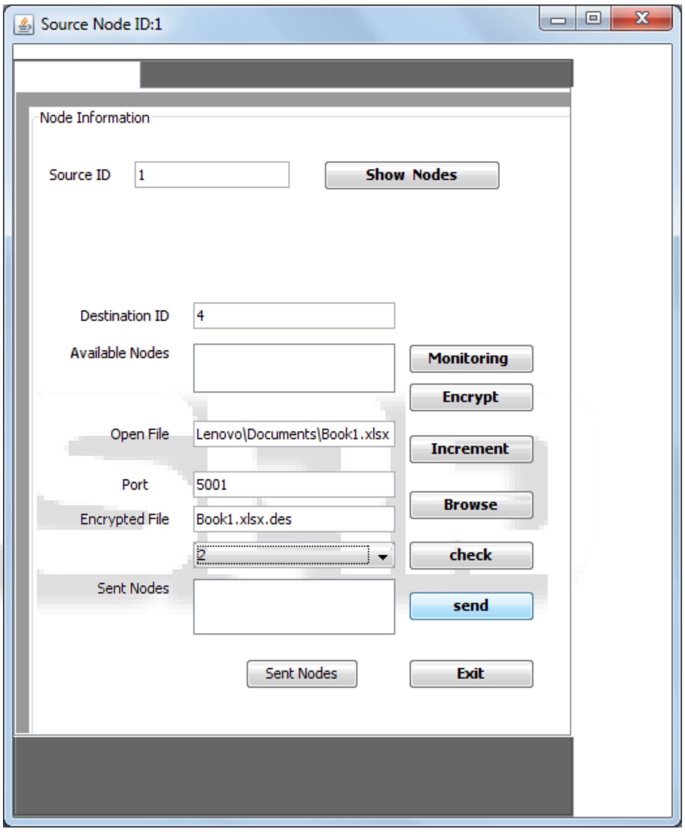


Fig. 5: file browsing and sending to internal nodes

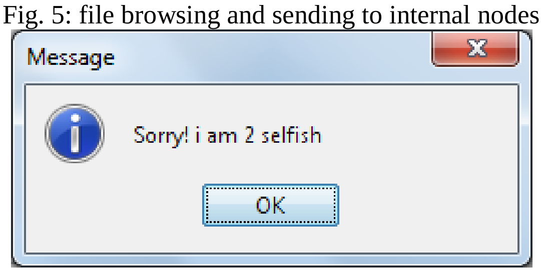


Fig. 6: selfish node

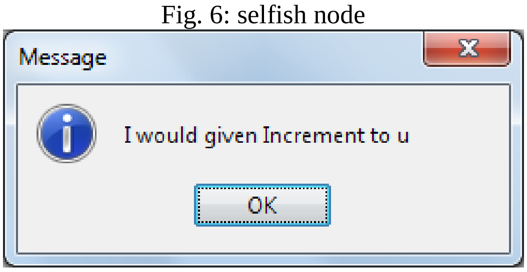
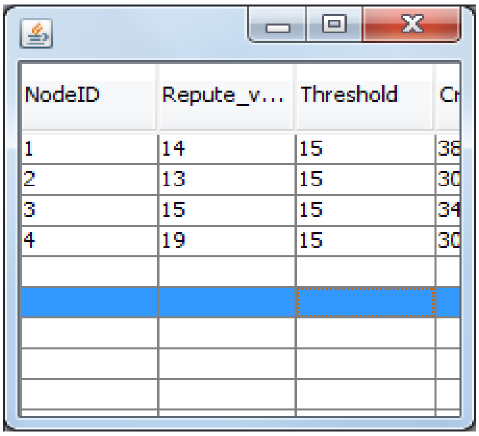


Fig. 7: Incrementing Node2



NodeID	Repute_v...	Threshold	Cr
1	14	15	38
2	13	15	30
3	15	15	34
4	19	15	30

Fig. 8: Reputaion values,credits after incrementing

E. *Node2 Increment And File Received Process*

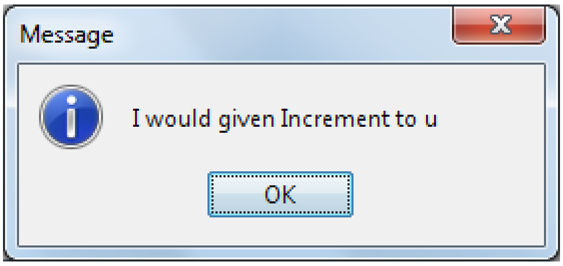


Fig. 9: Incrementing Node2 again

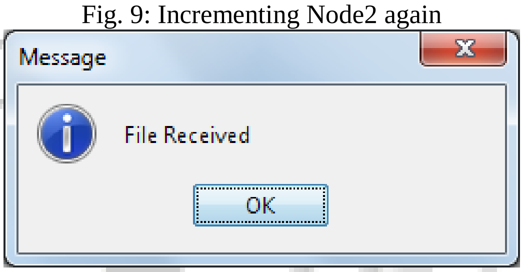


Fig. 10: File received

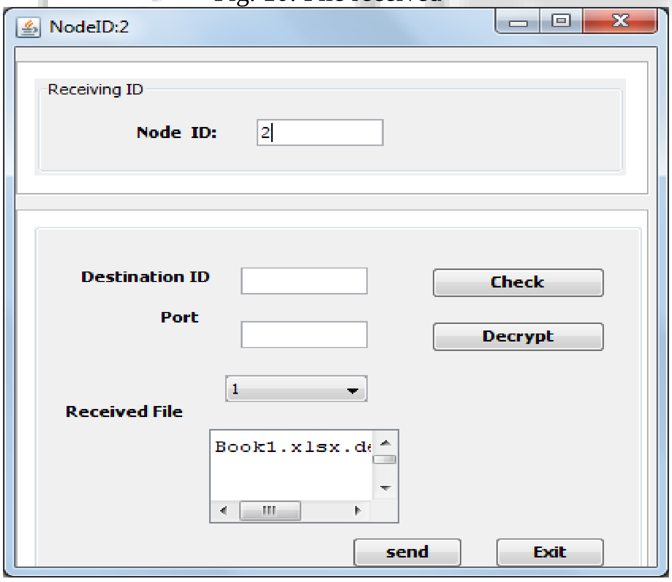


Fig. 11: Node2 receiving file

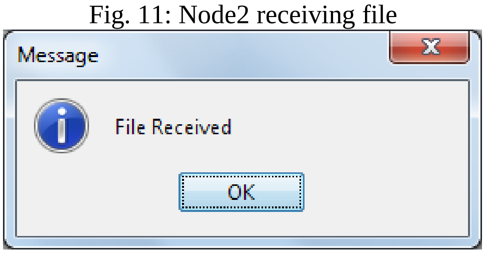
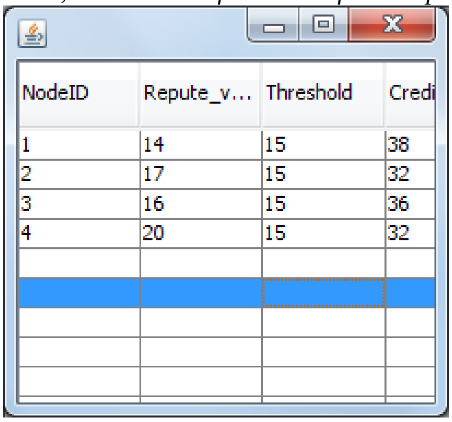


Fig. 12: Received file

F. *Reputation, credit values for nodes after co operating*



NodeID	Repute_v...	Threshold	Credi
1	14	15	38
2	17	15	32
3	16	15	36
4	20	15	32

Fig. 13: reputation credit values

VI. CONCLUSION

Analyze the underlying cooperation incentives of the two systems and a defenceless system through game theory. To overcome the observed drawbacks in each system, we propose and analyze an integrated system which leverages the advantages of reputation systems and price-based systems. This shows the higher performance of the integrated system compared to the other two systems in terms of the effectiveness of cooperation incentives and selfish node detection. The current integrated system aims to provide stronger cooperation incentives but does not focus on security issues such as compromised cooperative nodes or attacks on the system. And our enhanced work provides security to the data forwarded by the encryption technique. This provides security by encrypting the packet in sender and then it forwards to the intermediate node. And the packets are decrypted by the receiver node; obviously the packets are not hacked during data transmission.

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