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Secure and Minimum Expenditure Data Transmission in MANET Avoiding Selfish Nodes using Game Theory

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Mobile Ad hoc Network (MANET) is an infrastructure less, dynamic network consisting of a collection of wireless mobile nodes that communicate with each other without the use of any centralized authority. Because of its easy maintenance, infrastructure less architecture, self organization and disaster management capabilities it plays a great role in modern development of commercial applications. But, because of the dynamic topology, shared wireless medium, distributed cooperation and limited resources, MANET is vulnerable to various kinds of security attacks. One of the major problems is dropping packets by selfish nodes. Due to the limited resources, nodes in MANET very often act selfishly. Presence of selfish nodes in MANET may damage the entire communication system. So, it is highly required to detect those selfish nodes and promote cooperation in MANET. Here, a new game theoretic scheme has been proposed for selfish node detection in MANET. Besides detection of selfish nodes, using Least Total Cost Factor (LTCF), data packets will be transmitted from source to destination node through least cost path only. Due to the presence of selfish nodes in the network, if a path has been broken, then the next best path will be automatically selected for data transmission. So, this scheme guarantees secure low cost data transfer and smallest amount of idle time.

Keywords : AODV, LTCF, MANET, Selfish Node.

1. INTRODUCTION

MANET can be defined as a network that has large number of autonomous or free nodes. It is autonomous, decentralized, flexible and supports multi hop routing. Besides numerous advantages, MANET has some vulnerabilities, such as lack of centralized authority, limited bandwidth, limited power supply, limited availability of resource, dynamic topology, routing overhead etc. MANET is based on the assumption that each node is co-operative and trusted. But in reality, some of the nodes may act selfishly. These selfish nodes use the network and receive services from other nodes but they do not cooperate with other nodes of the network. The establishment of multi-hop routes in an ad hoc network relies on the fact that every node will forward packets for one another. However, a selfish node, in order to conserve its limited energy resources, could decide not to behave cooperatively. If every node of the network decides to act selfishly, then the entire network could be collapsed.

Game theory tries to focus at the relationship between the participants in a particular game model and then predicts their optimal decisions. It can be used to find out how the performance of MANET may be affected by the selfish nature of nodes. A game is made up of three components : a set of players, a set of strategies or actions and utility function or payoffs. In MANET, the players are the nodes of the network. The actions are the different alternatives available to each player. When each player chooses an action, the resulting action profile determines the outcome of the entire game. Using game model, steady-state conditions known as Nash equilibrium can be iden-

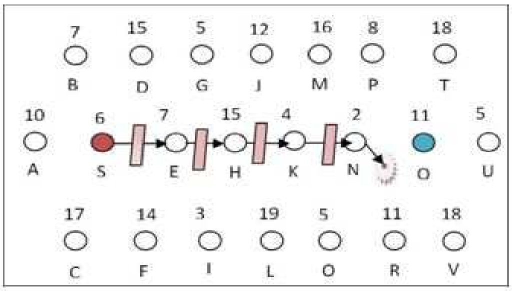

Figure 14. N Drops Data Packet

Path	TCF	Rank
S-E-H-K-O-R-Q	42	1
S-E-G-J-K-O-R-Q	44	2
S-E-G-J-M-P-Q	48	3

Figure 15. Remaining Valid Paths

the database and the remaining paths will be re ranked as shown in Figure 15.

Now, LTCF will be modified as 42.
The selfish nodes detected till now are I and N. So, these two selfish nodes will be removed from the network. So, after removing these two selfish nodes I and N, the network looks like as Figure 16.

Again data transmission starts through Rank 1 path S-E-H-K-O-R-Q. After some tines if for

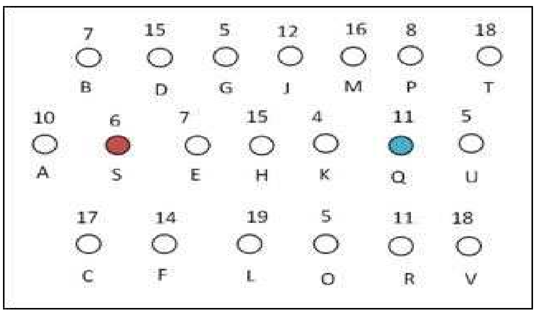

Figure 16. After Removing Selfish Nodes

Path	TCF	Rank
S-E-G-J-K-O-R-Q	44	1
S-E-G-J-M-P-Q	48	2

Figure 17. Remaining Valid Paths

any reason if an intermediate node H of this path cannot communicate with its neighbor nodes, then that node sends a RERR message to source node and removes all information related to the transmission path from its routing table. On receiving RERR message, source node S will be informed that this path has been broken and next ranked path will be selected for data transmission. So, the remaining paths will be ranked as Figure 17.

So, now rank 1 path S-E-G-J-K-O-R-Q is selected for data transmission and modified LTCF is 44. Each time when a data packet reaches the destination node Q, destination node Q replies with an acknowledgement message, *i.e.*, ACK message. This ACK message will be forwarded in reverse order through the same path via which source node S sent data packet to the destination node Q (Figure 18). Finally, when ACK message is sent back to the source node, the source node S is informed that data packet has reached destination node Q successfully. This process continues for data packet sending from the source node to the destination node.

If after some times for any reason, these two paths are broken or discarded, then there will not be any valid path left in the database. Then the source node S will again broadcast RREQ message to its neighbor nodes for finding out some new routes to the destination node Q.

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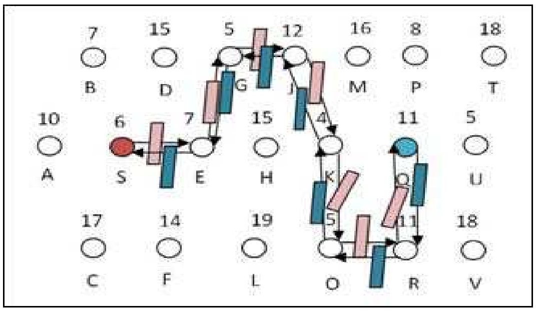

Figure 18. from Q to S ACK Packet is Forwarded

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