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A LEARNING AUTOMATA-BASED FAULT-TOLERANT ROUTING ALGOR/ITHM FOR MOBILE AD HOC NETWORKS

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ABSTRACT
Reliable routing of packets in a Mobile Ad Hoc Network (MANET) has a major concern. The open medium and the susceptibility of the nodes of being fault-prone make the design of protocols for these networks a challenging task. The faults in these networks can eventuate to packet loss. Such losses decline the performance of the routing protocols running on them. In this paper, we propose a routing algorithm, which is known as learning automata based fault tolerant routing algorithm, which is ale for routing in the presence of faulty nodes in MANETs using multipath routing.

KEYWORDS: MANET, Learning Automata, Fault tolerance.

INTRODUCTION
MANETs are dynamic and continuously changing networks, which are having groups of nodes. Designing a routing protocol for such an environment is a difficult task. Ubiquitous communications using MANETs require support of reliable routing protocols. The situation gets worse when there are faulty nodes in the network, as it increase the data loss and decline the performance of protocols. Learning automata has been traditionally used to design biological learning systems. The learning cycle involves two components, the Random Environment and a Learning Automaton. The process of learning is performed by interacting with the RE, and computing its responses to find the best action.

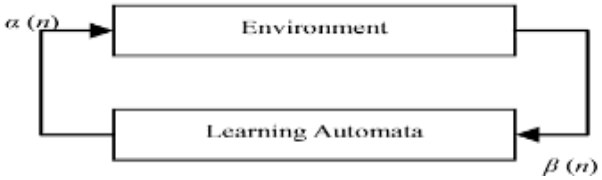

Fig.1 Process of Learning Automata [1]

End-to-End Fault tolerant routing algorithm is a state-of-the art algorithm, in which routing is based on end-to-end computation using a route estimation and route selection process. Route selection is done by two procedures: Confirmation and Dropping. Confirmation is a procedure which selects a path from a given set of paths with the packet delivery ratio. Dropping is a procedure which drops a given path if the packet delivery ratio is less than the given threshold value. The application of MANETs is varied, choice from small, stationary networks that are controlled by power resource to comprehensive dynamic networks. The application of MANETs need well organized distributed algorithms to decide the network association, routing, and link scheduling though determining a feasible routing path and message delivery. Relevant issues such as changeable wireless link excellence, fading, path loss, topological changes and power exhausted. The network could be capable to flexibly modify the routing paths to improve these problems.

Routing protocols for MANETs
Routing in MANETs is currently a challenging and interesting problem studied by the community primarily due to the dynamic nature of the infrastructure present in MANETs, e.g., due to nodes joining and leaving the network. For routing, the transmission of data from one node to another is direct, if the source and destination nodes are neighbors, i.e., if they are within the wireless range of each other. On the other hand, the transmission is indirect, if the source and destination nodes are not within their range of operation [7]. In such a case, routing is achieved through a series

of multiple hops, with intermediate nodes between the source and the destination nodes serving the purpose of routers for relaying the information in between. The dynamic nature of the topology of MANETs due to the constant migration of nodes renders routing considerations difficult. The following characteristics of MANETs make their routing further challenging [7]:

1. The terrain in which the mobile nodes operate in MANETs may pose to be hostile with hazardous conditions that can lead to the frequent failure of the nodes and their mutual links.
2. The medium of transmission of information in MANETs is wireless. Wireless media are relatively unreliable, insecure, and quite susceptible to different kinds of errors and unwanted noise.
3. MANETs operate with battery-powered nodes, which are normally low powered, and resource constrained. If the region of operation of the nodes is in a hostile terrain, the frequent recharging of the nodes may not always be feasible. Consequently, all routing algorithms should be energy-efficient, of low complexity, and should be capable of operating under limited bandwidth. The different types of errors that can occur in MANETs are the following [7]:

1. Transmission errors
2. Node failures
3. Link failures
4. Route breakages
5. Packet loss due to congested nodes/links.

RELATED WORK

In [5] Zhou,Xia proposed area based fault tolerant routing algorithm (FTRA) .In this calculation in view of geological area data systems isolated into lattice. Flaw may happen the proposed calculation select backup course of action from unused at bounce in ordinary directing way, the course determination relies on area data of its neighbour's networks. In [6] Qin and Pang proposed adaptation to non-critical fault-tolerance cluster head based (FTCH) directing convention lessen acting mischievously hub in the system. Defective hub happens the proposed convention give parcel conveyance division ensure and diminish steering overhead.

Sudip Misra et.al [1] proposed a model Trusted Fault Tolerant (TFT) used in Location Aided outing (LAR) protocol. LAR focused link faults, high mobility, node congestion and capacity of buffers. The Location fault occurs the destination node move away from source. The proposed model considers that node is selfish or misbehaving node. It improves the location awareness and node trust level based on recovery of the lost packet. In [2] AkyildizI and Ahamed proposed a new fault tolerant routing protocol extends of DSR protocol. In this protocol identify at least two paths between sources to destination. Link failure occurs in one path immediately select another path.

Ad hoc and sensor systems utilization cross-observing plan [7] to attain to dependability and survivability in the issue identification and rectification model .This paper presents a convention conveyed self-diagnosis protocol, called Dynamic-DSDP [8]. It discovers hard and delicate blames in an altered measure of time.
In [9] record replication method utilized portable specially appointed system for imparting the records. In [10] concentrate on check guiding recuperation administration, it spares recuperation data by lessening the recurrence of plate access.

The execution examination of FTCH contrasted and MMMH, AODV and DSR. Rouzi et.al [11] present a diagram called deficiency tolerant 1-spanner. It is utilized to secure least vitality ways. Likewise called as k-Fault-Tolerant 1-Spanner it produced least vitality way tree for fizzled hub set. To uproot the fizzled hubs in the system the starting system will get vitality structure it. Changed Cluster-based QOS directing calculation [12] with the objective of giving adaptation to internal failure in QoS. This calculation assess hub disappointment in light of disappointment recuperation time, throughput, dropped bundle and stream data transfer capacity. In [14] propose an End-to-End estimation Fault Tolerant Routing Algorithm (E2FT) for misbehaving nodes. Route estimation and Route selection are the two process used to choose multiple path to packet delivery and also increase the accuracy of estimation. In [15] introduce cache management method to raise the TCP throughput by avoiding the host failures in the network by respond directly from the DSR cache. Nazeeruddin et.al [16] proposed a distributed agent based dynamic host auto-configuration protocol. Every node has address, the IP addresses can be allocate to the new node, without check with further address agents. This protocol handles message losses and node failure.

LEARNING AUTOMATA

Learning Automata (LA) is a self-operating learning model, where "learning" refers to the process of taking knowledge during the execution of a simple automaton and using the gained knowledge to choose actions to be taken in the future. This model has three main components—the Automaton, the Environment, and the Reward/Penalty structure [1].

AUTOMATON

The Learning Automaton can be represented as a quintuple represented as {Q, A, B, F, H}, where:

- Q: is the finite set of Internal States Q={q1,q2,q3,..., qn}where qn is the state of the automaton at instant n.
- A: is a finite set of actions performed by the automaton. A = {α1, α2,..., αn}where αn is the action performed by the automaton at instant n.
- B: is a finite set of responses from the environment. B = {β1, β2, β3,..., βn} where βn is the response from the environment at an instant n.
- F: is a mapping function. Maps the current state and input to the next state of the automaton. $Q \times B \rightarrow Q$.
- H: is a mapping function. Maps the current state and response from the environment to determine the next action to be performed [13].

LAFTRA-LEARNING AUTOMATA BASED FAULT-TOLERANCE ALGORITHM

In LAFTRA, we propose to maintain a goodness value table at each node. We also propose a new packet header goodness update message. There are reward and penalization schemes used in it.

Reward scheme

The LA at each node will apply a rewarding scheme on successful packet delivery. LA will reward the node in the following manner:

Reward function
if (current node=destination)
G=G+R;
Y=G;
else if ($Y \leq T$) G=G+R;
$Y = \eta \times G + (1-\eta) \times Yn-1$
Else
G=G+R;

Penalty scheme

The LA will penalize the node if there is a packet delivery failure in the following manner:
Penalization function
if (current node=destination)
$G = G \times P$;
Y =G;
Else
G=G+R;
$Y = \eta \times G + (1-\eta) \times Yn-1$

PERFORMANCE METRICS

- Packet delivery ratio: It is defined as the number of packets successfully delivered divided by the total number of packets sent.
- Overhead: Overhead is the number of additional control packets to be sent in a given time to maintain proper network operation. The higher the frequency of updates, the larger will be the overhead.

CONCLUSION

In this paper, we proposed an LA-based fault-tolerant routing algorithm for MANETs. LAFTRA achieves a high packet delivery ratio and less normalized packet overhead during the increase in the number of faulty nodes in a network.

However, if the nodes in the network are highly mobile with very small pause time, then it would not give the desired performance result. Initially, the proposed algorithm learns the network, after which it would outperform other benchmark algorithms. If the network changes heavily in the learning phase, then performance of proposed protocol will suffer in terms of overhead.

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