Survey on Multipath Optimized Link Sate Routing Algorithm for Flying Ad-hoc Network

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Abstract— A disaster relief operation demands an efficient communication among recover teams. The real time information provides the responders and emergency management centers are important for saving lives. In such scenario FANET is suitable for providing communication for the fewer infrastructures. The multi-Unmanned Aerial Vehicle (UAV) system is used by flying ad-hoc network (FANET) each single UAV is handling by the particular coverage area of the ground base. In this paper considered the relief and rescue operations to apply the flying ad-hoc networks. The UAV to UAV communication used by the clustering algorithm of UAV networking. Adaptive MAC layer protocol scheme for UAV design the node parameters and control packages with its directional antenna using AMUAV protocol can improve throughput, end-to-end delay and bit error rate for mutli- UAV systems. It is considering the routing protocol as Multi Path –OLSR takes the advantages of GPS information.MP-OLSR protocols are planned to the dynamically changing topology and to evaluate the trusted based nodes to be well behaved. A trust reasoning model based on Fuzzy Petri net method is presented to evaluate trust values of fly nodes.
Key words: FANET, UAV, Clustering Algorithm of UAV, AMUAV, MP-OLSR, GPS

I. INTRODUCTION

In this paper introduced the flying ad-hoc network communication used by different UAV's. To transfer the mobility node provide the cluster based algorithm and provide the cluster header communicate the other nodes. The adaptive MAC layer protocol scheme for UAV design the node parameters and control packages with its directional antenna using AMUAV protocol can improve throughput, end-to-end delay and bit error rate for mutli-UAV systems.

A. Manet

The purpose of using MANETS Mobile Ad hoc Networks in multichannel cluster based architecture is to provide efficient routing topology among multiple sink nodes that are responsible for intra cluster communication. Each sink node is responsible for maintaining a cluster tree structure by sending a signal to neighboring node in process of establishing a channel for message sharing and in broad cast of information form one node to another [4]. Some of the authors had focused their research towards using hybrid network including base stations, terminal nodes, sink nodes and relay nodes deployed inside a particular building for data collection in particular disaster conditions [11].The strength of the research work depends upon energy storage capacity of sensor nodes which provides efficient mechanism to broadcast the messages for the long period of time. kung et al [12] had proposed a capability maturity Model Integration for Drought Forecast and the possible decision making using the Intelligent decision support system. The authors had proposed Drought Forecast and Alert System using ecology monitoring sensors that senses and transmits the specified environmental conditions to specific data base server which is responsible for passing this information to integrated services server for intelligent decision making. The mobile and satellite users are also attached with the main integrated services server which is responsible for decision making depending upon the environmental conditions.

B. Fanet Networking Models

In FANET many routing protocols exists in wireless and ad-hoc networks to increase the FANET operation time, there are some needs to decrease transmitting power by sending a message to closer nodes (UAVs) and by using multi-hop routing between the sender and receiver nodes over highly mobile UAVs as relay nodes. FANET is a subclass of VANET and MANET; therefore, firstly typical MANET routing protocols are preferred and tested for FANET. Due to the UAV-specific issues, such as these protocols are not directly applicable for FANET. Therefore, to adopt this new networking model, both some specific ad-hoc networking protocols have been implemented and some previous ones have been modified in the literature. These protocols can be categorized in four main classes;

- Static protocols have static routing tables there is no need to refresh these tables.
- Proactive protocols, also known as table driven protocols, are periodically refreshed routing tables.
- Reactive protocols, also called on-demand protocols, discover paths for messages on demand.
- Hybrid protocols use both proactive and reactive protocols. By using these routing protocols, a FANET can dynamically discover new routes between communicating nodes, and this network may allow addition and subtraction of UAV nodes dynamically.

C. Antenna Technology

The development trend of antenna technology is intelligent, functional diversification, and massive-scale. The system can track and communicate high-speed mobile objects. Therefore, the control and monitor of the HST and UAV are feasible. The functional diversification of antennas can be realized by multi-band and multi-mode antennas.

D. Mac Protocol Layer

MAC protocol can be categorized as synchronous or asynchronous in operation, it can also be distinguished by who initiates a communication request the receiver node.

II. RELATED WORKS

A. Group Mobility

In disaster scenario, the rescue task is always performed as integration of various teams or groups. Group mobility model stands for the team or group movement in the real scenario, where either a function creates group behavior or the nodes are somehow arranged with a group header In our framework, we have considered attraction/ reference point group mobility model

B. Heterogeneity

In this paper we consider heterogeneity in terms of three environment values.
1) Movement of nodes: Normally we consider movement on a plane, but in hilly areas it will be more suitable to consider the movements in height also.
2) Path followed/Routing: There can be situations when the link which was followed recently, is
3) not available now.
4) Density of nodes. The number of peoples at the disaster location may also vary depending on the geographical location of the site.

C. Quality of Service Provisioning in Mobile Ad-Hoc Networks

QoS for a network is measured in terms of the guaranteed amount of data which a network transfers from one place to another during a certain time. The QoS is identified as a set of measurable pre-specified service requirements; such as delay, bandwidth, probability of packet loss, and delay variance (gitter). Therefore, a network needs to meet such requirements for the end users to satisfy a particular application while transporting a packet stream from a source to its destination. The traffic types in ad-hoc networks are quite different from other infrastructures and the widespread use of wireless technologies in MANETs make the QoS approaches more complicated.

D. Wireless Sensor Network Field

The wireless sensor network field in case of disaster consists of four adjacent cells in a neighboring hood network. Each cluster in particular network architecture consists of four ad hoc relay stations covering each cluster. The sensor nodes within each cluster are surrounded by ARS and in middle the head node is responsible for communicating with all the nodes within the sensor field. Each cluster with in a network is directly interfaced with Sink node that is responsible for maintaining communication path between head nodes within each cluster towards base station. The base station uses GSM based or wimax based communication system that is responsible to transfer disaster affected information from cluster based network architecture towards emergence response center.

E. Mobility Prediction Clustering:

It operates on the dictionary of Trie-structure calculation algorithm and link termination time mobility model to guess network topology updates. In this way, it can build more constant cluster formations.

F. Clustering Algorithm of UAV Networking:

It constructs the clusters on the ground, and then updates the clusters through the mission in the multi-UAV system.

G. Routing Procedure

The protocol selection for routing is based on the scenario support. Here we have taken few assumptions like entities or group of entities tend to move towards a specific destination area (inter or intra layer movement) & follow a defined path used for movement and pause time of the nodes is taken as a monotonic function. To test the mobility frameworks performance we have considered MP- OLSR.

H. Trust Models for FANET

Trust is the degree of belief about the future behaviors of other entities. It is based on the past experience and the observation of actions. Trust model is the method to specify, evaluate, set up, and ensure trust relationships among entities. Only entities behaving normally and properly are evaluated as trustworthy.

I. Trust based Reasoning Model

Fuzzy Petri net is a combination of classical Petri net and fuzzy logic. Since it supports structural organization of information, provides visualization of rule-based reasoning, and facilitates design of efficient reasoning algorithm, fuzzy Petri net has been widely recognized as a promising modeling mechanism for formulating fuzzy rule-based reasoning.

III. LITERATURE REVIEW OF MP-OLSR

There are mobility metrics which can be used to observe the mobility policies. Relative velocity, maximum velocity, acceleration, pause time are some examples. Those metrics can be observed for different mobility model and can conclude some facts regarding the mobility characteristic of those models. Varying those characteristics, we can draw how much those metrics are important for a protocol operation. We use following parameters as performance evaluation metrics of our proposed mobility model.

A. Packet Delivery Ratio

Packet delivery ratio counts the number of packets originated by the source and number of packets received by the receiver. During communication, nodes move from its position continuously with different velocity. We can compare the ratio of packets send by sender and received by receiver to evaluate the effect of our changes parameter of mobility over the performance of network.

B. Average End to End Delay

Packet delay is time that packet takes from source node to destination. In MANET, packet relays from several intermediate nodes. So, delay of a path is summation of all the links along that path. Link fluctuates during the mobility of nodes. Some links along path may have high delay comparing to others. Average value gives the value that can be compared with other results. Average packet delay increases with mobility in MANET.

C. Flow Chart

Fig. 1: Flowchart

D. Algorithm

MultiPathOLSR(s, d, G, N)

C1 = C

G1 = G

For i = 1 to N do

SourceTreei =OLSR(Gi, s)

Pi = GetPath(SourceTreei, d)

For all arcs e in E

If e is in Pi or Reverse(e) is in Pi then

$C_{i+1}(e) = fp(C_i(e))$

Else if the vertex Head(e) is in Pi then

$C_{i+1}(e) = fe(C_i(e))$

End if

End for

$G_{i+1} = (V, E, C_{i+1})$

End for

return (P1, P2, …, PN)

Hop count in MP-OLSR

The delivery ratio of ETX first increases then decreases. This may be caused by the route recoveries and loop discoveries and the traffic jam. At the very beginning, when there is only one CBR in the network, in some scenarios, we observe an extra number of TC message generated in ETX. So some intermediate nodes may do the route recoveries and loop discoveries after that studied CBR arrived. The delay may make the nodes discard the data packets. It is more serious in ETX, for it has to spend more time waiting for ETX value.

E. Node Traffic

The hop counts are the same as those for MP-OLSR in 4.2.1. From the delivery ratio of ETX first increases then decreases. This may be caused by the route recoveries and loop discoveries and the traffic jam. At the very beginning, when there is only one CBR in the network, in some scenarios, we observe an extra number of TC message generated in ETX. So some intermediate nodes may do the route recoveries and loop discoveries after that studied CBR arrived. The delay may make the nodes discard the data packets. It is more serious in ETX, for it has to spend more time waiting for ETX value. Otherwise, it may choose the one or 2 paths only. So ETX performs worse than hop count at the very beginning. When more CBRs join in, the route discovery and loop recovery may already have been done when the background CBRs arrive, so the delivery ratio of the studied CBR increases. But when the background traffic becomes heavier and heavier, there will be traffic jam which resulted in the increment of delay and decrement of delivery ratio for both metric. But generally speaking, ETX does better than hop count to lessen the background traffic effect in our scenarios. This may result from its initiation to find "best" paths. But the difference is not significant. In terms of standard deviation of delivery ratio, ETX shows a more stable performance than hop count, especially in 4, 6 and 7-background-CBR point, for it tries to keep find "best" quality paths in various seeds with various maximum nodes speeds. Figure 4.11 delivery ratio of ETX and hop count Where there is more traffic, the intermediate nodes need more time to handle the longer queues. So the end-to-end delay of sending the studied CBR is larger and larger. ETX and hop count perform very similarly expect in scenarios with 4 background CBRs. When considering the standard deviation, we can see a sharp peak for hop count in 4-background-CBR point. We think it just a special case. In other words, these 2 metrics have very similar performances when dealing with background traffic in end-to-end delay. However, ETX can keep the QoS even if there is a special case.

F. Node Density

This performs similarly in end-to-end delay. It is very interesting that when the nodes number reach 35, the delay sharply drops down. This may be because when there are 35 nodes, links available are enough for multiple paths for the 3 CBRs, while there are 30 nodes, some chosen paths are duplicated. From the standard deviation, ETX and hop count are once again neck and neck. When there are a few nodes in a wide network, the difference in seeds and speeds make a big different in the performance of MP-OLSR, no matter what metric it uses. But when the nodes are enough, this effect will be lessened (this time the standard deviation is around 0.005). This causes the sharply drop down of standard deviation in 35-node point. Figure 4.15 end-to-end delay of ETX and hop count this time ETX still costs more in topology management than hop count. With the increment of node density, the cost increases too. This is because when there are more nodes, there are more Hello message and TC message to send.

G. Mobility

Since we fail to see the advantage to use ETX in the previous experiment, we carry out one more experiment – changing the nodes' mobility to see whether ETX is better. ETX is designed to consider the link quality and when the mobility is very big, the link quality changes a lot. So ETX is expected to have a better performance in this experiment. Following is the mobility parameter set. Other parameters are the same as the previous experiments. In case of end-to-end delay, hop count shows better in low speed while ETX does better in high speed. The reasons are similar as those for delivery ratio. In terms of deviation, ETX shows a more stable performance in different seeds. We can see that ETX costs almost 1.5 times than hop count to maintain the topology information. When the nodes move faster, the cost increases too. This is because when the mobility enlarges, more changes happen in the topology, more TC control messages should be sent.

IV. CONCLUSION

In this paper a trust reasoning model based on Fuzzy Petri net method is presented to evaluate trust values of fly nodes using clustering algorithm for UAV networks. The proposed algorithm used number of nodes is small and the mobility of them is faster. While hop count gains a better result when the node density is large and the node speed is not very fast. But ETX cost more than hop count in topology management. Because the difference between these two protocols is not large, there is not necessarily to conclude that ETX can improve MP-OLSR.

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