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Performance Analysis of Dynamic Routing for Flying Ad-hoc Networks

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Abstract- *Mobile Ad-Hoc Network is a self-configurable network. It will establish a network in on demand manner especially for battlefield communications. In such applications, intergroup communication is crucial to the team collaboration. To address this weakness, in this paper a new class of ad-hoc network called Flying Ad-Hoc Networks (FANETs) is introduced. A distributed client tracking solution to deal with the dynamic routing nature of client mobility, and present techniques for dynamic topology adaptation in accordance with the mobility pattern of the clients is proposed. The proposed system is two different routing algorithms for ad hoc networks: Optimized Link-State Routing (OLSR), and Predictive-OLSR (P-OLSR). The latter is an OLSR extension that is designed for FANETs. It takes advantage of the GPS information available on board.The simulation results indicate that FANET is robust against network partitioning and capable of providing high relay throughput for the clients. Depending on the high mobility of FANET nodes, the topology changes more frequently than the network topology of a typical MANET or even VANET. Multi-UAV systems may include different types of sensors, and each sensor may require different data delivery strategies.*

Keywords: – FANET, Routing protocols, UAVs , Sensor nodes, MANET,VANET.

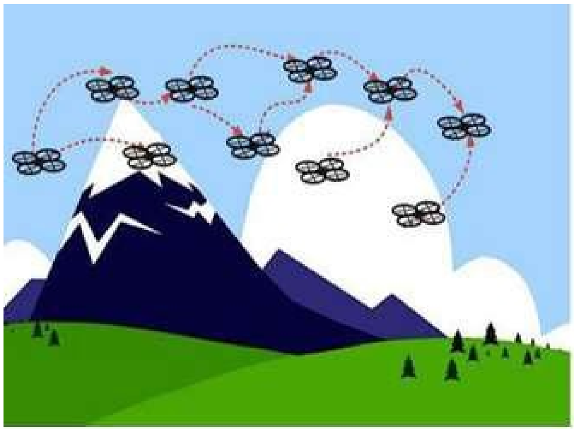
1. INTRODUCTION

FANETs (Flying Ad-hoc Networks) is a group of Unmanned Air Vehicle (UAVs) communicating with each other with no need to access point, but at least one of them must be connected to a ground base or satellite . UAVs work without human help, like autopilot. This is because cheaper and small wireless communicating devices, the in recent years, many research fields from academia and industry make attention on FANETs. Now, FANETs are used in various applications such as military and civil applications, such as managing wildfire and disaster monitoring. As each type of network has its own specification and using the protocol depends on this specification, it this kind of networks and check their performance using simulation. Two factors affect protocol simulation: the first one is mobility model, and the second one is the communicating traffic pattern, among others.

FANET can be viewed as a special form of MANET and VANET. Mobility degree of FANET nodes is much higher than the mobility degree of MANET or VANET nodes. While typical MANET and VANET nodes are walking men and cars respectively, FANET nodes fly in the sky. Depending on the high mobility of FANET nodes, the topology changes more frequently than the network topology of a typical MANET or even VANET. Depending on the high mobility of FANET nodes, the topology changes more frequently than the network topology of a typical MANET or even VANET. FANET also needs peer-to-peer connections for coordination and collaboration of UAVs. Besides, most of the time, it also collects data from the environment and relays to the command control centre, as in wireless sensor networks. Consequently, FANET must support peer-to-peer communication and converge cast traffic at the same time. Typical distances between FANET nodes are much longer than in the MANETs and VANETs. In order to establish communication links between UAVs, the communication range must also be longer than in the MANETs and

VANETs. This phenomenon accordingly affects the radio links, hardware circuits and physical layer behaviour. Multi-UAV systems may include different types of sensors, and each sensor may require different data delivery strategies.

2. SYSTEM ARCHITECTURE



3. FLYING AD HOC NETWORKS

This new Flying ad-hoc network to support such a dynamically changing mesh topology. Flying ad hoc networks (FANETs) composed of small unmanned aerial vehicles (UAVs) are flexible, inexpensive and fast to deploy.In this system that each flying node is fully charged in the initial location and has enough power to update its location and forward data for mobile clients. Flying nodes can be classified into Intra group routers and Intergroup routers. Therefore each flying mesh node is fully charged in the initial location and has enough power to update its location and forward data for flying mobile client. Also proposed autonomous wireless mesh network, deal with the dynamic routing.

4. IMPLEMENTATION DETAILS

Predictive Optimized Link State Routing (P-OLSR) is a routing protocol for wireless mesh networks. It is similar to OLSR in that it forms a route on-demand when a transmitting node requests one. However, it uses source routing instead of relying on the routing table at each intermediate device.

P-OLSR is an on-demand protocol designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table-update messages required in the table-driven approach. The major difference between this and the other on-demand routing protocols is that it is beacon-less and hence does not require periodic hello packet (beacon) transmissions, which are used by a node to inform its neighbors of its presence. The basic approach of this protocol (and all other on-demand routing protocols) during the route construction phase is to establish a route by flooding Route-Request packets in the network. The destination node, on receiving a Route-Request packet, responds by sending a Route-Reply packet back to the source, which carries the route traversed by the Route-Request packet received.

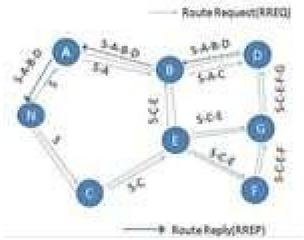


Fig 2.P-OLSR Process

5. PROPOSED SYSTEM

Flying ad hoc networks (FANETs) composed of small unmanned aerial vehicles (UAVs) are flexible, inexpensive and fast to deploy.In this system that each flying node is fully charged in the initial location and has enough power to update its location and forward data for mobile clients.

Here the advantages are: To achieve better overall end-to-end delay. Cost of the network should be less. Able to efficiently utilize all free routers to track UAV.

MODULE 1:. Network Topology
MODULE 2. Mobility Models
MODULE 3. Beacon sharing
MODULE 4. Dynamic Routing

1. Network Topology

Topology formation is an important issue in a flying adhoc network. Performance parameters such as energy consumption, network lifetime, data delivery delay, sensor field coverage depend on the network topology. Flying adhoc network mainly used for monitoring the events such as disaster tactical in military surveillance. In order to the higher mobility, degree, topology changed frequently. The communication between UAVs has also broken frequently; because the higher speed, or if the UAV is out of the range because location changing occurs rapidly. At each UAV connection failure, update processing is needed. Wireless Mesh Network (WMN) is a mesh network implemented over a wireless network system. It is a point-to-point-to-point, or peer-topeer, system. A node can send and receive messages, and also functions as a router and relay messages for its neighbors. Through the relaying process, a packet of wireless data will find its way to its destination, passing through intermediate nodes with reliable communication links.

2. Mobility Models

In node mobility, the degree is larger than MANET and VANET. The UAV has a speed of 30-460 km/h, and this Speed causes the communication problem between UAVs. In many mobility models, the flight plan is predetermined and at each step there is a change, recalculation for the map take place. Other models are using random speed and directions for the UAVs. The mobility of a network depends on two basic parts, nodes location and velocity change in a time.

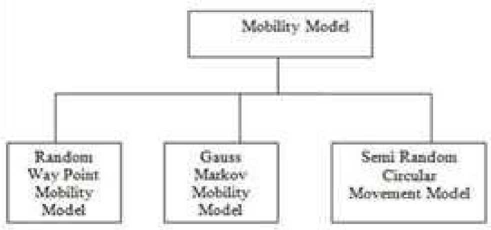


Fig 3. Mobility Model

3. BEACON SHARING

In a multi-hop network, links are usually established and maintained proactively by the use of one-hop beacons which are exchanged between neighbouring nodes periodically. Beacons are broadcast in order to conserve bandwidth, as no acknowledge messages are expected from the receivers of these beacons. Thus, the link status of every link on which a beacon is received can be effectively obtained through beacon transmissions. In addition, it is possible to protect the beacon using the RTS/CTS signalling of the MAC layer. In our proposed work, the Router need to track the mobile client and need to provide the continuous connectivity with less number of Router usage using beacon sharing. To use less number of Routers, routers need to share the client info message to each other. When node receives a CLIENT INFO packet from its previous node s, it can use the neighbor list in the

CLIENT INFO packet to estimate how many its neighbors have not been covered by the CLIENT INFO packet from If node has more neighbors uncovered by the CLIENT INFO packet from , which means that if node ni rebroadcasts the CLIENT INFO packet, the CLIENT INFO packet can reach more additional neighbor nodes.

4. DYNAMIC ROUTING

The nodes inside the network move around randomly and have no restriction on their distance from other nodes. As a result of this random movement, the whole topology is changing in an unpredictable manner, which gives rise to both directional as well as unidirectional links between the nodes. In a large area mission and multi-UAV operations, dynamic routing can occur. Therefore, robust algorithms with dynamic routing are make better communication with source to destination. The mobile nodes in FANET form on-the-fly communication backbone, which changes dynamically and arbitrarily over a period of time. There might be cases where a link between nodes might be in a transient state from unidirectional mode to bidirectional mode. Dynamic Source Routing is a reactive approach of routing in ad-hoc networks in which sending nodes recover the routes whenever they need to send data to the receiver nodes. In FANETs, the mobility is very high between the nodes; hence the possibility of route breakage between any two nodes is really high. Hence the packet is lost. Now, to minimize the packet loss, the route is maintained. In the process of data transfer, when the data is transferred from one node to the next an acknowledgement is sent back to the sender node .

P-OLSR METHODOLOGY

This section describes neighbor prediction scheme, and POLSR algorithmic approach. A. Neighbor Prediction Scheme Say position of node i at time t0 is (XA, YA, ZA) (point A) and we want to calculate position of node at time t1, where (t1 > t0) (point B). Now if difference of t1 and t0 is not much then it can be assumed that node i moves with same speed (speedi) and direction till t1 time. Let the direction ratio of node i are (dx, dy, dz). Then equation of line AB can be given by Below Eq.

$x – XA/dx = y – YA/dy= z – ZA/dz= k$ (1)

Now the question arises that how position, speed and direction ratio can be known in wireless ad hoc networks. Position of the nodes can be inferred from positioning techniques like Global Positioning System (GPS). Similarly, speed (*speedi*) and direction ratio (*dx, dy, dz*) can be inferred either from GPS or nodes own instruments and sensors e.g. campus, odometer, speed sensors etc. Instead, P-OLSR also uses radio range of node in its algorithmic approach. This radio range can be determined from transmission power and radio propagation properties.

P-OLSR PROTOCOL

I present an extension to the OLSR protocol named Predictive-OLSR (P-OLSR). The key idea of this extension is to use GPS information available on board and to weigh the expected transmission count (ETX) metric by a factor that takes into account the direction and the relative speed between the UAVs.

In this project, I present field experiments that compare P-OLSR against OLSR. The experiments involved two UAVs and a ground station. The carriers were fixedwing autonomous planes called *eBees* and developed by SenseFly. Each plane carried an embedded computer-on-module and an 802.11n radio interface. The field-test results show that P-OLSR can follow rapid topology changes and provide a reliable multihop communication in situations where OLSR

mostly fails. In order to assess the behavior of P-OLSR in larger networks, we carried out MAC-layer emulations considering a network composed of 80 UAVs. To the best of our knowledge, P-OLSR is currently the only FANET-specific routing technique that has an available Linux implementation. Nodes in mobile ad hoc networks are self organizing and self-administering. This allows communication without any preexisting infrastructure. Moreover, each node can move with different speed and direction. Speed and direction may not be constant. These may change rapidly and unpredictably over time. Thus routing a packet in MANET is a challenging task ,neighbor prediction scheme and modifies OLSR protocol. We call this modified OLSR as Predictive- OLSR (P-OLSR). Simulation shows that the performance of P-OLSR by adding our solutions increases significantly in terms of data packet delivery, throughput, latency and normalized overheads. It improves routing performance mainly in terms of packet delivery. The concept of position, velocity and range, and increases the performance in terms of packet delivery, throughput, latency and normalized overheads. Route may be computed whose next hop node is out of radio range: that entry in neighbor table depends on neighbor hold time.

P-OLSR uses 1-hop neighbor table and TC messages for the calculation of routing table. Since entries of nodes in neighbor table may be older, there is a chance that the next hop node corresponding to routing table entries is out of radio range. As position of neighbor can be predicted at any time, each node can find that its neighbor is in radio range or not. So, in MPRs calculation, nodes in P-OLSR consider only those neighbors which are in radio range at that time.

Furthermore, nodes consider the shortest path in routing table construction, whose next hop node is in radio range according to current position of that node. If the entry from routing table is selected whose next hop node is in out of range, node re computes its routing table and then

forwards the packet according to entry, defined in table. But if newly recomputed table does not contain any entry for that destination, nodes in P-OLSR simply drop the packet. As P-OLSR packet delivery results do not show much variation with increase in maximum speed of node, chances of wrong prediction of position is less for P-OLSR. In other words, the impact of faster node movement has greatly reduced after applying P-OLSR solutions. MPRs which are out of radio range does not transmit TC messages. This in turn gives rise to routing table construction with smaller number of nodes.

Optimized Link State Routing (OLSR) protocol is a table-driven proactive routing protocol for wireless mobile ad hoc networks. The key idea behind this protocol is to reduce the control message overheads by marking subset of neighbors as Multi-Point Relays (MPRs). We discuss problems of OLSR or other routing protocols that are due to mobility of nodes. We integrate our solutions to OLSR protocol and call it as Predictive- OLSR (P-OLSR). Performance evaluation of OLSR and P-OLSR is done through NS2 simulation. Simulation results show that P-OLSR outperforms OLSR with respect to packet delivery, throughput, latency and normalized overheads.

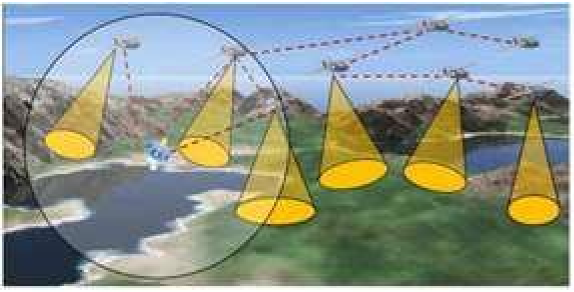
These messages are used for neighbor sensing and MPR calculations. These are transmitted periodically to all its 1-hop neighbors. HELLO message includes link type, willingness of node to become MPR, information about its neighbors etc. Link type in these messages indicates that link is symmetric, asymmetric or simply lost. OLSR maintains one shortest path entry in routing table for every node in networks. When node has a data packet to forward, it reads the entry from its routing table and forwards the packet to the next hop, defined in routing table. Modification to OLSR for vehicular ad hoc networks, termed as OLSR-MOPR, is suggested in OLSR-MOPR utilizes position, velocity and range for the calculation of life of the node. It uses this life of

node in the selection of MPR and in routing table construction. utilizes current neighbor position as a mobility prediction parameter.

6. ALGORITHM

1. Initialize a counter: counter=0;
2. For each sensing time interval, t do
3. For each UAV to do
4. if UAV is connected to base station (BS) by single-hop (i.e., condition (4) is satisified) then
5. Estimate the new location after time t basenode the current velocity and transmits range
6. if UAV will still be connected to BS based on estimated location in step 7, then continue with the current settings for UAV .Increment the counter by 1.
7. Otherwise adapt the transmission range and change the direction of a given UAV towards BS with the help of angle of arrival , and GO TO step 6 end if
8. Else if UAV is not connected to BS then
9. Check if it has neighboring UAVs. If not , adapt transmission range and check if it can reach other UAVs. If yes , continue with existing settings and increment the counter by 1.
10. Check if at least one neighbor exists , estimate location and check if it is reachable after t time. If not , change the direction and transmit range , and GO TO step 10 end if.
11. end for
12. Successful probability P=Counter/N.
13. end for

7. FANET DESIGN CHARACTERISTICS



A FANET scenario to extend the scalability of multi- UAV systems

Topology change Depending on the higher mobility degree, FANET topology also changes more frequently than MANET and VANET topology. In addition to the mobility of FANET nodes, UAV platform failures also affect the network topology. When a UAV fails, the links that the UAV has been involved in also fail, and it results in a topology update. As in the UAV failures, UAV injections also conclude a topology update. Another factor that affects the FANET topology is the link outages. Because of the UAV movements and variations of FANET node distances, link quality changes very rapidly, and it also causes link outages and topology changes

8. CONCLUSION

In a FANET, one of the objectives of the movement is to maximize region coverage. One of the basic services provided by a wireless detector network is monitoring the specified region. We addressed the problem of dynamic routing in mobile client partitioning by applying the mobile target detection technique in mobile Fly devices name as UAV based Seamless Connectivity Solution.The proposed a enhanced solution for our basic FANET model to avoid the Fly Rob failure. The proposed system extra-mobile fly's for failure recovery unit. Here successfully tested our proposed system with NS2.

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