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Adaptive Communication Protocols in Flying Ad Hoc Network

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ABSTRACT

Unmanned aerial vehicles (UAVs) have already been applied to solve problems in a variety of application areas including real-time surveillance, electric power lines inspection, search and rescue, forest fire monitoring [1], and so forth. As the UAV application range constantly expands, its working condition is getting more complex, and is always unknown and dynamic. Accordingly, multiple UAV systems have increasingly been addressed, and their cooperation can complete some tasks that cannot be completed by a single UAV system. Meanwhile, a higher requirement for autonomy is put forward in multiple UAV systems, which leads to ever increasing demands for portable and flexible communications. Ad hoc networks, which allow communication between devices without the need for any central infrastructure, are preferred in the UAV area. In this area, the flying ad hoc network (FANET), a new paradigm of wireless communication, is emerging [2]. It can govern the autonomous movement of UAVs and support UAV-to-UAV communication, considering each flying UAV as a router and without complex hardware deployment. Moreover, a FANET provides an effective real-time communication solution for multiple UAV systems. However, there are some challenging issues regarding communications and networking [3] to overcome. First, the UAVs (FANET nodes) are highly mobile with speeds ranging from 30 to 460 km/h in three-dimensional space. Hence, the communication links between UAVs fiercely fluctuate and are extremely unstable. Second, frequent topology changes increase the packet loss, routing overhead, and communication delays. High moving speed, long distance between flying nodes, environmental uncertainties, failures of flying nodes, and so on result in link interruption, and a new routing path needs to be established. Other factors like mission updates may also cause topology changes. Moreover, low latency, high reliability, and robustness must be considered in some military and emergency rescue applications. Conclusively, a FANET is characterized by rapid changes and activities, and designing efficient communication protocols is fairly challenging.

1 Statement of the Problem

Currently, the existing communication protocols of FANETs are heuristic built-in rules, which heuristically specify which UAV node, and when and how to connect in what conditions. They are easy to realize, and can optimize and fit the network communications temporally. However, the complicated flight environment and varied flight tasks lead to the status of FANETs being in unpredictable stochastic fluctuation. Accordingly, such heuristic communication protocols are hard to use in such an environment and cannot adapt to changes in real time, which may deteriorate the network communication performance in the long term.

2.Methodology

In the FANET scenario of this article, there are several flying UAVs as the nodes whose number ranging 5 to 20. Each flying node is equipped with a GPS and an identical switched beam antenna array whose switching time between the antenna beams can be or ignored, and has its own node ID and can publish its own position $\{x_i , y_i , z_i \}$ and velocity $\{vx_i , vy_i , vz_i \}$. Our proposed communication protocols include two protocols, the PPMAC protocol with the MAC layer and the RLSRP protocol within the network layer, to provide a comprehensive and high-performance protocol scheme for FANETs. The proposed protocols use two cooperative transceivers to operate concurrently, where one of them takes charge of position release and interchange of control packets, and the other one takes charge of data transmission; they are denoted as TS 1 and TS 2, respectively. Accordingly, the control and data channels are separated, and the overall network capacity is enhanced. In the following subsections, the PPMAC protocol and RLSRP protocol are represented.

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PPMAC Protocol:

The PPMAC protocol includes three phases: position prediction, communication control, and data transmission. The exact position of each flying node is predicted and estimated at the position prediction phases. Some key control packets are interchanged at the communication control phase. The data is transferred from a flying node to a neighboring flying node at the data transmission phase. Position Prediction: The directional antennas have a requirement that the specific position of each flying node must be known. In PPMAC, each flying node directionally transmits its GPS-coordinate vector. In FANETs, each flying node can be a position sender without any contention. As illustrated, the position packet includes the node ID, the GPS-coordinate indicating the current position of a node, the current status of data transmission, the current antenna bearing of TS 2, and the route information. Hence, each position packet brings only an extra 17 bytes of overhead for the MAC layer.

When a flying node is a data sender, it first directionally transmits its GPS-coordinate vector through TS 1 and publishes the position packet clockwise. Notably, the position packet is sent to the nodes in the directional antenna transmission range. At that point, the neighboring nodes are switched to listeners and postpone their information transmission to avoid collision. Accordingly, the range of position transmission is confined to one hop between neighboring nodes; thus, the network overhead is reduced significantly. Meanwhile, the position packet shares the information of the node status and current antenna bearing among the nodes in a FANET, which can get rid of the problem of head-of-line blocking [13]. Similarly, if the sender node is aware of the current position and movement velocity of its listener, it can estimate accurately the position at subsequent time t

3.Objective of Project

1.The protocol must improves the traffic performance
2.The given approach must identify the destination location more efficiently
3.The Flynet UAV should give higher delivery rate and shorter delivery delay

4.SYSTEM ANALYSIS

EXISTING SYSTEM

At present, the current correspondence conventions of FANETs are heuristic worked in rules, which heuristically indicate which UAV hub, and when what's more, how to interface in what conditions. They are simple to acknowledge, and can upgrade and fit the system interchanges transiently. Be that as it may, the entangled flight condition and fluctuated flight errands prompt the status of FANETs being in flighty stochastic vacillation. In like manner, such heuristic correspondence conventions are difficult to use in such a domain and can't adjust to changes progressively, which may disintegrate the arrange correspondence execution in the long term. Subsequently, a versatile and profoundly self-sufficient convention arrangement that can create and set up correspondence connects adaptively and self-governingly is wanted.

DISADVANTAGES

- The existing protocols are heuristic policy-based, which have a low degree of autonomy and cannot satisfy the performance demands of high mobility, the complicated flight environment, and varied flight tasks.
- The communication protocols of FANETs covering MAC protocol and network protocol have just started and been unable to meet the actual needs.
- The existing hybrid approaches that works at MAC layer and network layer simplify some assumed conditions, lacking of robustness and reliability

5. PROPOSED SYSTEM

We propose adaptive communication protocols, including the medium access control (MAC) protocol and the routing protocol. The main contributions of this article can be summarized as follows:

• We propose a novel position-predic tion-based directional MAC protocol for FANETs (PPMAC). It combines the directional antennas and position prediction in the MAC layer, and overcomes the directional deafness problem.

• We propose a self-learning routing protocol based on reinforcement learning for FANETs (RLSRP). It allows updating the local routing policies with the position information of UAVs and a reward function defined based on the global network utility, while avoiding the necessity for other global knowledge of the networks. The proposed routing protocol can evolve automatically.

• The proposed communication protocols are more robust and reliable, and can guarantee fast link establishment and successful data delivery with low latency.

6 ADVANTAGES

- Improves the traffic performance
- Identify the destination location more efficiently
- Higher delivery rate and shorter delivery delay

7.REQUIREMENT SPECIFICATION:

Required Hardware:-

- Core2 Dueo prosecesor is essential
- 1.1 Ghz speed is needed
- 1_GBRam Required
- 20_GBHard_disk

Required software:-

- LINUX /WindowsXP
- Network Simulator-2
- O TCL

8.CONCLUSION

A FANET can provide an effective real-time communication solution for multiple UAV systems, but at the same time it also faces some challenging issues in communications and networking. We propose adaptive hybrid communication protocols including PPMAC and RLSRP. Simulation results show that the proposed communication protocols outperform the existing protocol schemes and can guarantee fast link establishment and successful data delivery with low latency. The first contribution of this article is that the proposed protocols can overcome the directional deafness problem. The second is that our proposed intelligent and adaptive protocol solution can develop communication operations according to the states and the environmental evolution of the flying UAVs. The third is that the proposed protocols are robust and reliable. Finally, our proposed hybrid adaptive communication protocols have the potential to provide an intelligent and highly autonomous communication solution for FANETs, and point out the main research orientation of FANET protocols. In this work, we only consider the simplest mobility model, and in the future, we will consider more mobility models of flying UAVs. In addition, we plan to optimize the calculating speed of the RL-based routing protocol to improve the flexibility and practicality. We will scale up the FANET size where more nodes are in place to examine the performance of the proposed protocols further.

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