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A Brief Survey of Mobility Model for FANET

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ABSTRACT-FANET(Flying Ad-Hoc Network) is a infrastructure less network. One of the most important design problem for multi-UAV(Unmanned Air Vehicle) system for FANET is the Mobility which is necessary for cooperation and collaboration between the UAV. To address this problem various Mobility model of FANET are introduced. Mobility Model define path and speed variations of the UAV and represent their position. Until now, Random Way Point Model is used as fabricated one for Mobility in most of simulation scenarios. Random Way Point model is not applicable for UAV because UAV do not change their direction and mobility speed hastily at one time due to this reason, we consider more realistic model, called Semi Random Circular Movement(SRCM) Mobility Model. In addition we study various mobility model- Mission Plan Based (MPB) Mobility Model, Paparazzi Mobility Model (PPRZM), and Pheromone Based Model .

Keywords: FANET, Ad-hoc Network, UAVs, MANET, VANET, Mobility Model

I. INTRODUCTION

FANETs are a special case of mobile ad hoc networks (MANETs) that are characterized by a high degree of mobility[1]. In a FANET, the topology of the network can change more frequently as compare to MANET or vehicle ad hoc network (VANET). One of the most important design challenge for the multi UAV systems is the communication. Unmanned Aerial Vehicle (UAV) systems fly autonomously without carrying any human help. Usage of UAVs promises new ways for both military and civilian applications[2] ranging from search and rescue operations to disaster monitoring. FANET develop a group of small UAVs will form a special kind of ad hoc network Architecture. This type of networking architecture is called Flying Ad Hoc Networks (FANETs) which also have unique challenges other than MANETs or VANETs. In FANET each UAVs can connect directly through the satellite or ground station to establish an ad hoc network among all UAVs . Ad hoc network between UAVs, is one of the most effective communication architectures for multi UAV systems . By the help of its multi hop communication schema, FANET architecture certify that all UAVs are connected to each other and to the base station or satellite for all time without any infrastructure, even if a UAV cannot directly communicate with the base station or satellite. In this way, not only it can transfer the collected data to the control centre immediately, but also it can support the inter-UAV communication which is crucial to realize the collaboration among UAVs[3]. FANET have high mobility degree as comparison to other ad hoc network . However, because of high mobility of the UAVs, the topology of FANET nodes changes very frequently, and all-time connectivity becomes an important constraint for the FANET based multi UAV task planning. distance between UAV nodes is larger. High gain antenna is required to achieve longer range. long range transmission can also help to reduce hop count and enhance latency performance. most UAV perform real time operation (video transmission etc), where high data rate is required. this leads to high bandwidth requirement compared to MANET or VANET.

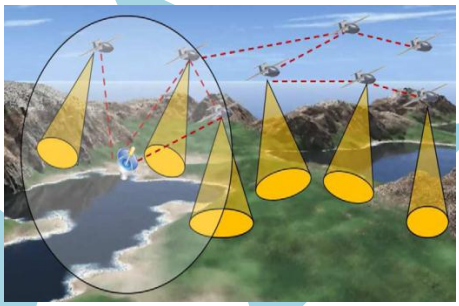

Fig 1[2]

FANET treat as a MANET and VANET. But, differ in many ways :

a)Mobility degree of FANET nodes is much higher than the mobility degree of MANET or VANET nodes. While typical MANET are mobile nodes such as mobile phones, laptops etc and VANET nodes are vehicles such as cars bikes, FANET nodes fly in the sky..

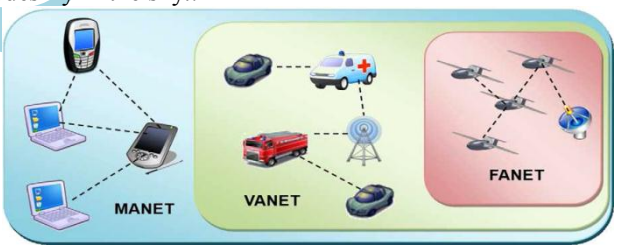

Fig 2 Physical View of MANET , VANET , FANET

b) Due to the high mobility of FANET nodes, the topology changes more frequently than the network topology of a typical MANET or even VANET.

c)The existing ad hoc networks aim to establish peer-to-peer connections. 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 center, as in wireless sensor networks. Consequently, FANET must support peer-to-peer communication and converge cast traffic at the same time[2].

d)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

II. MOBILITY MODELS

Mobility models Represent the movement of node and how their location ,velocity and acceleration change over time. mobility models are used to create a realistic simulation environment. it showed how the performance of an ad hoc protocol can vary significantly using different mobility models. They compared the impact of the most common mobility models on a well-known ad hoc routing protocol.

a)Random way point mobility model RWP (Random Way Point Model) is a straight trajectories. each UAV nodes select a random destination moves with a random speed and pause time at the destination. when the pause time expire node choose another random position and moves with another speed value at this location. UAVs decide on their action according to fixed probabilities.

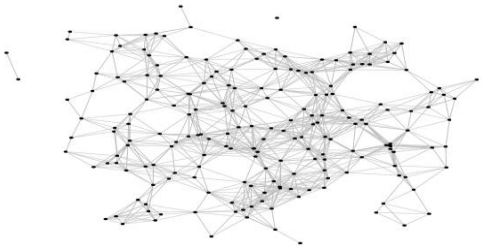

Fig 3 . Random way point Mobility Model

Until now, random waypoint model is used as synthetic one for mobility in most of simulation scenarios. however , it is not suitable for aircraft case because aircraft do not change their direction and mobility speed rapidly at one time and cannot stay for a while at the same point like random waypoint model. This mobility models are based on three actions: going "straight" , "turn left" and "turn right" [4].

b)Pheromone based model

Pheromone model based on the pheromone map, and the pheromones guide UAV movements. each UAV marks the area that it scans on the map, and shares the pheromone map with broadcasting. in order to maximize the coverage ,UAVs prefer the movement through the area with low pheromone smell. it was shown that the use of a typical MANET mobility model may result in undesirable path plans for cooperative UAV applications it was also observed that the random model is remarkably simple, but it leads to ordinary results[2]. however the pheromone base model has very reliable scanning properties. with the pheromone model, a pheromone map is used to guide UAVs. the aircraft exchange information about their scanned area, and according to what they decide, they turn left, right or go straight ahead.

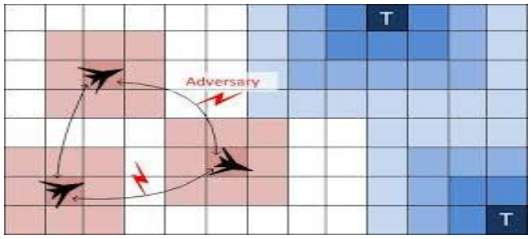

Fig 4 Pheromone Based Mobility Model

c)Semi random circular movement

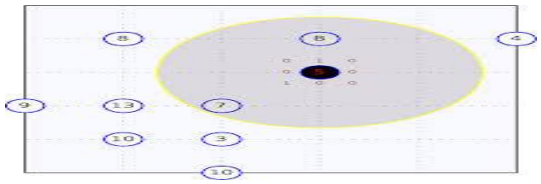

Fig 5 Semi Random Circular Mobility Model

This mobility model is designed for the curved movement scenarios of UAVs[4]. it is applicable for simulating UAVs turning around a specific position in order to gather some information. mobility model with hexagon route rather than random waypoint model for unpredicted helper node such as UAVs, their flight plan is not predetermined. in this model at every instant ,each aircraft is looking at different place where it chooses the desired object in a square area.

d)Mission Plan Based Mobility Model:

In MPB model, aircraft are already aware of the entire abundant trajectory information which is usually planned in advance it implies that the aircrafts travel along the predetermined path consistently where potential target location information is available. in MPB mobility model , the mobility files are created and updated frequently after some period of time is over .[6]mission plan based mobility model for aircraft which is supposed to move towards or away from destination. for each aircraft, starting and ending point are randomly selected while velocity and flight time are given. if an aircraft reaches destination before flight time is over, it changes direction to the starting point and continues flight as round trip.

Fig 6 Mission Plan Based Mobility Model

e)Paparazzi mobility model(PPRZM):

According to paparazzi experts, paparazzi UAV have five possible movements:

- Stay-At -> UAV hovers over a fixed position.
- Way-point-> UAV follows a straight path to a destination position.
- Eight-> aircraft trajectory has the 8 form around two fixed position.
- Scan-> the UAV performs a scan of an area defined by two points along the round trip trajectories.
- Oval->a shifted round-trip between two points with a turn around once pass each point.[4]

Paparazzi mobility model is a stochastic mobility model that imitates paparazzi UAV behavior based on the state machine. PPRZM has closer behaviour to the real traces than RWP.PPRZM can be used to evaluate any communication protocol in the context of swarm of collaborative UAVs since

it affords a realistic movement scenario[4]. for instance it may be used to compare several routing protocols in order to find the suitable one for each UAV ad ho network. Moreover, PPRZM can adapt to any type of mission because it groups most UAV possible movement by changing the probability of each movement type as needed.

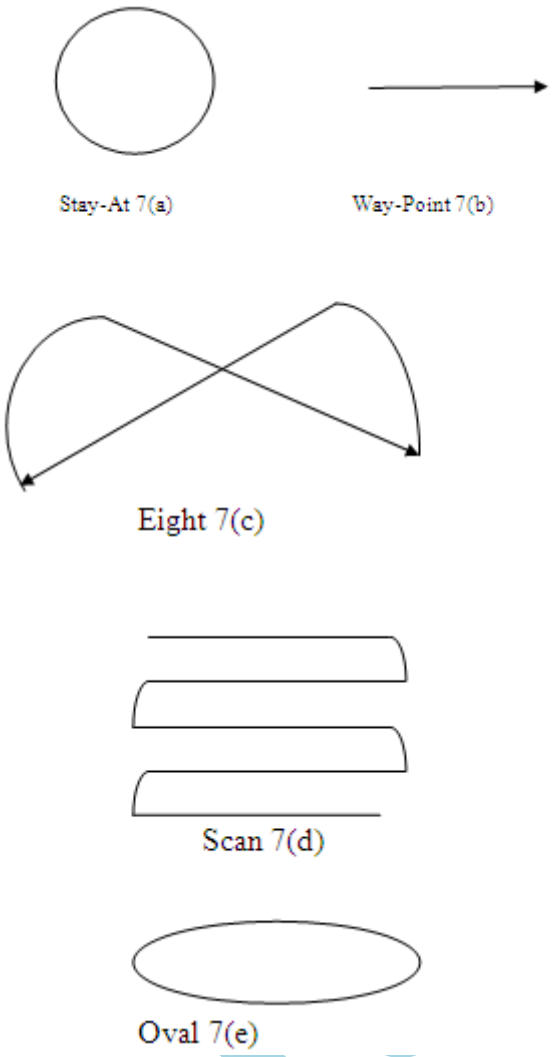

Fig 7. Paparazzi Mobility Model

III.CONCLUSION

In this paper we have presented some brief intro of some mobility models for FANET. Mobility is one of the most challenging problem for FANET. we have discussed the difference between FANET and other ad hoc network.

IV. FUTURE SCOPE

In this paper , we have studied some mobility model .As future work we want to compare all these mobility model using one routing protocols.

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