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A Comprehensive Learning on the Organizations of Wireless Adhoc Networks

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ABSTRACT

In this fast moving world, drones plays a vital role and usage of drones are growing fast in both civilian and military applications. Drones can fly autonomously in different environment and achieve various missions. Due to its well advanced applications in the past few decades, the requirement of drones with different size, weight and usage became unavoidable in the current scenario. Also in this recent years the research and development based on the Flying adhoc network has doubled. This is because of the growing demand of unmanned aerial vehicles in the applications like military and civilian. In this paper different types of drones listed out from macro to the advanced one based on their defined applications.Also Multi drones can be used in a network called as flying adhoc network to ensure Civil and Military applications. Flying Ad-Hoc Networks (FANETs) is a group of Unmanned Air Vehicles (UAVs) which complete their work without human intervention. The selection of routing protocol for this high level dynamic FANET topology depends on the following factors like nature of the applications task and services,characteristics of unmanned aerial vehicle and constraints and the ability of flying.Two factors which affect protocol simulation are mobility model and communicating traffic. Moreover wireless communication scheme with a proper routing protocol which ensures proper coordination among the drones and improves the network performance is to be proposed in future pattern

KEYWORDS: FANET, MANET, VANET, UAV

I.INTRODUCTION

Nowadays wireless networks are picking up ubiquity and popularity in computing industry.[1] There are two categories of wireless networks traversing from well-known infrastructure network to infrastructure less adhoc networks. Most well-known one's infrastructure network are personal area networks, Bluetooth, Cellular Networks and Wireless Local Area Networks (WLANs).[2] With the ever expanding request for network, the requirement for wireless communication is inevitable.[3,4]

An adhoc network comprises many group of mobile nodes with wireless transceivers. [5]It doesn't depend on the predetermined infra structure. Adhoc networks creates connections temporarily among the nodes to exchange information. For the case condition as like if the information doesn't rely within the communication range, then the other intermediate nodes must be used to relay to achieve communications. [6,7,8]Adhoc networks widely used in the wireless networks also in military applications, sensor networks, rescue and disaster relief, and emergency response.[9,10]

In the last 2 decades, Wireless networks have shown fasted developed to strengthen the mobile communications Mobile wireless networks is categorized as two types.[11,12,13] The first type belongs to a network with infrastructure. In this type the mobile node a mobile terminal completes communication with the support of the nearest base station within the communication range. Only mobile switches are responsible for the routing and switching functions and it doesn't do routing.[14,15]

The second type execute without base station. This is highly recommended to the terminals of network with limited network coverage where 2 terminals which communicate / forward packets directly with the support of other nodes. In this type all the nodes can dynamically maintain contact with everyone, moreover each node acts a router to discover and maintain routes to other nodes.[16-20]

Adhoc networks can create wireless connections in which all the nodes in the networks can communicate each other for about 100 m without any wifi router and access point. In wireless adhoc networks, routing refers to the transformation of information from source to destination and the routing protocol is a protocol to implement the process of routing and a tool for sharing routing information between routers[20,21,22,23]

The routing protocol works at the network layer and is answerable for gathering information about the current state of the network, and for tracking down the optimal transmission path also for managing the routing table for the future packet transmission.[24-26]MANET uses Multi-hop routing (or multihop routing).It's a type of communication in radio networks in which if the network coverage area is larger than radio range of single nodes then nodes will use other nodes as relay to reach destination.MHR depends upon the routing protocol.[27-32]

II. RELATED WORK

Mobile adhoc network, a wireless adhoc network comprise many nodes/devices / terminals/routers which possess the ability to communicate each other without the support of the centralized administrator. This is made possible because of the networking capability and wireless communications of the devices.[33,34,35] Also everyone is responsible to do maintenance, routing and management. This is Called Peer level Multi Hopping and that is the main building block for Ad Hoc Network. This MANET doesn't hold any existing fixed networks moreover it dynamically forms a network to exchange. Adhoc networks are more complex and difficult than other wireless networks.[36,37]

The Mobile ad-hoc network consists of Autonomous Wireless devices with self-configuring characteristics without any centralised infrastructure as shown in Figure 1.

MANET devices are free to move independently. The network can be set at any place and at any time. The nodes are small and light equipment. This network is self-configuring.[38,39]

Dynamic: The nodes can move freely and autonomously toward any direction. The network topology may change any time randomly[40,41]

Multi-hop: Every node acts about as a host and as a router where the hubs are connected through remote directs in the network.[42] The message goes through numerous hubs from the sender to the recipient because of the limited transmission range.[43-45]Power: wireless has a limited bandwidth and the nodes have restricted battery power. Subsequently, power consumption is a generous plan streamlining condition.[46]

Infrastructure-less: This is an infra structure less network. Creates temporary networks. The hubs are quickly deployable; for example, when the hubs are in the transmission ring, they make an adhoc network self-organizing: Completely depends on the support and coordination from the participating nodes.[47,48,49]

Scalability: This is an issue, MANET faces during large sized network due to limited bandwidth and power

Low Bandwidth: wireless network has more limited transmission range than the fixed infrastructure network. Along these lines, its communication is lower than wired correspondence because of the effect of blurring, interference noise and multiple access.[50]

Every node in this MANET network must be responsible to route the packets and this is the domain of adhoc routing. During routing process, the route which might be established between source and destination should consists of two or more intermediate

nodes. Due to rapid change in the network topology the finding of routes and maintenance is very crucial problem. Routing protocol is more challenging in an adhoc network. The three categories of routing protocols: (i) table-driven (ii) on demand-routing and (iii) hybrid routing protocol.[51]

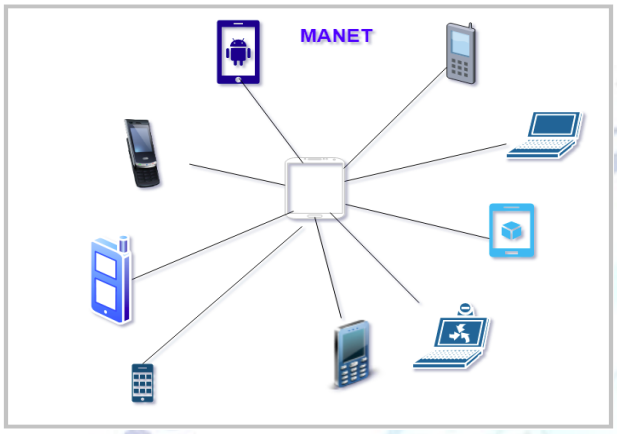

Figure 1: MANET

The routing information is periodically advertised to all nodes. So, every nodes holds an up-to-date status of the network like DSDV in table-driven routing protocols (also known as proactive routing). On-demand routing protocols (also known as reactive routing) finds new route only when there is necessity. DSR and TORA are the examples. The last type is hybrid routing protocols which delivers a competent steadiness between proactive and reactive protocols. Here new routes are established and existing routes are improved. It may reduce the communication cost to initiate moreover finding a new route still expensive. On-demand routing protocol are recommended to make use of cache to avoid the process of rediscovery.[52-55]

Capability of node depends on Acceleration, pause time, speed, direction, and movement pattern are the parameters plays vital role in defining the capability of nodeetc. The network scenario used Node density, bandwidth, signal propagation, number of nodes and simulation time as constraints. Even though stationary nodes are easily approachable, it leads to frequent and rapid link breakage. Unexpected results in emergency situation could be the result of this breakage. In real life applications like conference management system; video/audio conferencing etc. low mobility characteristics made fixed network scenarios as a feasible one. Routing decision for every individual packet.

Finding the efficient path in routing and managing the mobility schemes are the challenges of the routing protocols in this fast moving topology. The mobility models are evaluated under end to end delay and efficient data transmission. Moreover the moment pattern of a node is measured in terms of its location, velocity, speed, direction and acceleration etc. Also the routing protocol is responsible to find the reliable and authentic nodes for secure data transmission in the random environment.

Proper utilization and management of the energy assigned to every node is one of the challenging problem otherwise it may lead to communication break. By adjusting transmission range and transmission power of a node, energy consumption could be minimized.[56-58]

III.VANET

Vehicular ad-hoc network and Flying ad-hoc network are the sub categories of MANET as shown in Figures 2 & 3. The mobility change is very high in FANET and VANET than MANET.[59]Based upon the definition of the European Car Communication Consortium (C2C-CC) VANET architecture is divided into 3 different domains such as in-vehicle communication (the in-vehicle domain), workshop communication (the ad-hoc domain) and vehicle-to-road communication (the infrastructure domain). [60-62]The communication between on board unit [OBU] and user terminal confines the in vehicle communication. Moreover, the user terminal is the specific device / virtual module integrated into the OBU. The connection mode can be wired or wireless. Workshop communication (ad-hoc domain) comprises communication among OBUs (V2V), and communication between OBUs and RSUs (V2R).Single hop or multi hop are the communication mode used in this adhoc domain. Vehicle-to-road communication (the infrastructure domain) which possess Dedicated Short-Range Communication (DSRC) which includes the communication among OBU, RSU and infrastructure, such as satellites, Hot Spots, 3G and 4G, etc., to successfully access the Internet. Road side unit connections are wired. [63-67]

In vehicle domain, infra structure domain and adhoc domain utilizes wireless access methods. Ecall is the one of the communication method used in VANET, which

uses GPS positioning and a 2 G network. If ecall devices receives airbag deployment (sensor signals), in turn activates communication module and dial 112. Vehicle GPS coordinates, accident time, license plate number gets activated and initiates voice communication with the local rescue team. [63-67]

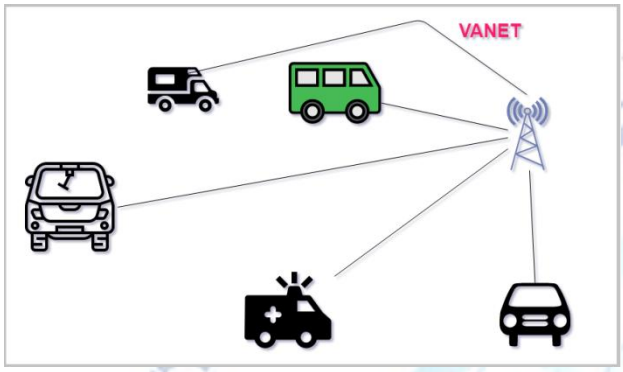

Figure 2: VANET

3.1. Characteristics of VANET

The rapid mobility of vehicle confirms the frequent changes of the topological structure in the on-board self-organizing network which in turn shortens the survival time of the communication link between two vehicle nodes. The transmission power and communication distance are inversely proportional to the throughput of the network in VANET.Vehicles dynamically changing topological structure leads difficulty in establishing an accurate neighbour node list however concludes most difficult for every node to manage the global topological structure of the entire network [63-67]

High-speed vehicle concludes rapid channel fading and a severe Doppler effect. However, the quality of the wireless channel is very unstable because of the impact of road conditions, tall buildings, and trees. Vehicles in VANET uses Global positioning system which in turn supports the network with accurate timing and vehicle location information. For the networking and routing protocol design, electronic maps support VANET. Speed, acceleration, direction, and other status information of the vehicle node are collected by various functional sensors. [63-67]

In MANET the communication module is powered by battery as a result energy saving becomes a key consideration in the protocol design process. In VANET, vehicle process power and for the communication equipment this scenario reduces power consumption and device volume requirements.

. [63-67]

IV. FEATURES OF VANET

VANET uses modern vehicles which consists of the following listed equipment's, such as,

1. Sensors and actuators.
2. Human machine interface
3. Event data recorder
4. GPS
5. Forward & Rear Radar
6. Communication facility
7. Computing platform[68]

In VANET, vehicle to vehicle as well as vehicle to the pre-installed infra structure communication is established. VANET supports Multi hop communication for vehicles out of Range. On board unit is a device which is responsible to collect and process data from various sensors also gives condition to the vehicles above all it is responsible to communicate with other vehicles and infrastructure. Road side unit is an infra structure for the communication between the cars.

The following are the techniques used by Intelligent Transportation system,

1. Wireless communications
2. Computational technologies
3. Sensing technologies
4. Blue tooth detection
5. Video vehicle detection
6. Key factors for Vehicle to Vehicle Communication (V – V)
7. Multi-hop / multi cast techniques
8. Native broadcasting
9. Intelligent Broadcasting
10. Key factors for Vehicle to infra structure Communication
11. High bandwidth link with vehicle and roadside equipment
12. Roadside units broadcast messages
13. The followings are the key parameters behind the objective of VANET
14. Traffic efficiency[68]
15. Traffic congestion,
16. Access to information and news
17. Avoid accidents
18. Entertainment purpose while driving.[68]

V. FANET

FANET stands for flying ad-hoc network. Networks which operate in a flying object are called as FANET. The FANET network is highly dynamic fast changing. They could be created in terms of helicopters, planes, Drones or UAV's. But now drones are much popular. Many drones can be communicated and coordinated together. There are two types of popular topology as like star [easily deployable] and mesh [attractive]. FANET is the subset of VANET.For the data transmission in FANET, the collaboration and coordination among the nodes in the network is more crucial. The node behaviour in FANET is measured by the concept of trust.

This concept of trust improves the reliability of the information exchange among the nodes and also it supports in isolating the non-cooperative and malicious network nodes. The routing protocols fails to achieve throughput in VANET or MANET due to fast moving mobile devices. Moreover, the topology of FANET changes more frequently than VANET or MANET.[69-70]

IEEE 802.11a and 802.11s is the network topology being used for the for implementation of FANETs in the mesh ad hoc network extension. flying ad hoc network is powered by jet, and pre-programmed flight plans remotely piloted. This is Unmanned Aerial Vehicles (UAVs). UAV-to-UAV (U2U) and UAV– Infrastructure communications (U2I are the two types of communication in FANET.Multihop communication is the technique used among the nodes to transfer data. In this network one node is linked or connected to the infrastructure

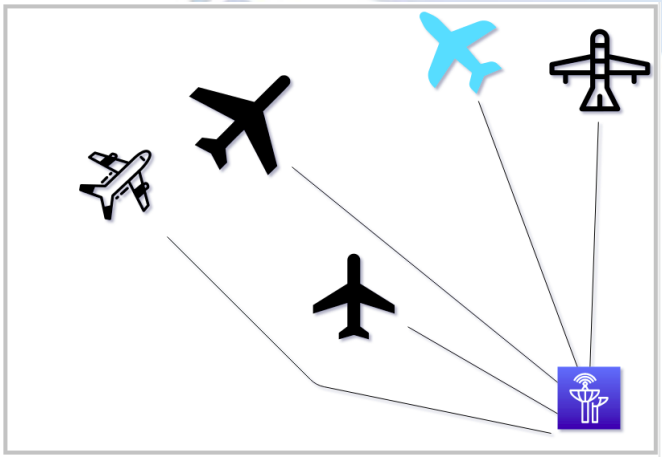

Figure 3: FANET

and the rest of the nodes communication is done using multi hop techniques. So it is clear that it's not necessary for all the UAV flights to have direct connection or communication with satellites or ground station always.

Lack of suitable algorithm for data routing is the major issue to be addressed in this network. FANET supports the Flying Unmanned aerial vehicle or Drone to exhibit real time communication and to achieve their targets with the support controlling station. Crisis, natural disaster, military combat zones, and package delivery are few areas where flying drones / UAV's dominates as applications.

Drone is an unmanned system which is meant to perform a machine more than a preprogramed machine.It is not possible to send the data to the base station.It has limited on-board intelligence.It is an unmanned lite vehicle.Designed to perform preprogramed missions[69-70]

VI. DRONES

In this fast moving world, drones play a vital role and usage of drones are growing fast in both civilian and military applications. Drones can fly autonomously in different environment and achieve various missions. Due to its well advanced applications in the past few decades, the requirement of drones with different size, weight and usage became unavoidable in the current scenario. Also in this recent years the research and development based on the Flying adhoc network has doubled. This is because of the growing demand of unmanned aerial vehicles in the applications like military and civilian. In this paper we have listed out different types of drones from macro to the advanced one based on their defined applications. Also Multi drones can be used in a network called as Flying adhoc network to ensure Civil and Military applications.[71]

Drone is an aerial vehicle without human on board. But it is remotely operated or controlled by a human operator sometime remotely controlled by on board computers. Also it is one of the components in unmanned aerial systems. Webster 's dictionary describes Drone as Pilot less air plane operated in Radio signals [71].

The unmanned aerial system (UAS) consists of the following components such as:

Unmanned Aerial Vehicle (UAV)

Ground Control Station (GCS) – Operational Control Center

Payloads – Defines the size of the UAV

Data Links – Describes two-way communication on the positioning of UAV, payload, etc.

Drones are the flying robots are getting widely used nowadays in military planetary and rescue operations. Advances in fabrication, navigation, remote control capabilities, and power storage systems triggered the development of drones in various applications whereas as the presence of humans is difficult, impossible, or dangerous. The configuration differs based on the platform and mission. Drones are classified as MAVs (Micro or Miniature Air Vehicles), NAVs (Nano Air Vehicles), VTOL (Vertical Take-Off & Landing), LASE (Low Altitude, Short-Endurance), LASE Close, LALE (Low Altitude, Long Endurance), MALE (Medium Altitude, Long Endurance), and HALE (High Altitude, Long Endurance).[72]

The types of the drones are basically classified on the following parameters

1. Technology used
2. Size and appearance
3. Level of the Autonomy
4. Flight range
5. Wingspan
6. Wing loading
7. Range
8. Maximum altitude
9. Speed
10. Endurance
11. Production cost
12. Engine types[73,74]

Table 1.*Classifies drone based on the weight. Cavoukian categorized drones as three main types, namely, micro and mini UAVs, tactical UAVs, and strategic UAVs.[73,74]*

Class	Type	Weight range
Class I(a)	Nano drones	W≤200 g
Class I(b)	Micro drones	200 g < W≤2 kg
Class I(c)	Mini drones	2 kg < W≤20 kg
Class I(d)	Small drones	20 kg < W≤150 kg
Class II	Tactical drones	150 kg < W≤600 kg
Class III	MALE/HALE/Strike drones	W > 600 kg
	Super heavy	W > 2000 kg
	Heavy	200 kg < W≤2000 kg
UAV's	Medium	50 kg < W≤200 kg
	Light	5 kg < W≤50 kg
	Micro	W≤5 kg
	Micro	W < 2 lbs
	Mini 2	lbs≤W≤30 lbs
Tactical UAVs	Tactical	30 lbs≤W≤1000 lbs
	Medium and high altitude	1000 lbs≤W≤30,000 lbs
	Heavy	W > 30,000 lbs

Table 2.*Classifies drone based on the weight ranges and flight range. [73,74]*

Designation	Weight range	Flight range
Micro and mini UAVs close range	W≤5 kg 25	km≤R≤40 km
Lightweight UAVs small range	5 kg < W≤50 kg	10 km≤R≤70 km
Lightweight UAVs medium range	50 kg < W≤100 kg	70 km≤R≤250 km
Average UAVs	100 kg < W≤300 kg	150 km≤R≤1000 km
Medium heavy UAVs	300 kg < W≤500 kg	70 km≤R≤300 km
Heavy medium range UAVs	500 kg≤W	70 km≤R≤300 km
Heavy UAVs large endurance	1500 kg≤W	R≤1500 km
Unmanned combat aircraft	500 kg < W	R≤1500 km

Table 3. *Classifies drone based on the weight ranges and wingspan.Also nowadays the drones are manufactured based on the advancement in the ICs and technologies. [73,74]*

Types	Weight	Wingspan
UAV	5 kg to 150000 Kg	2 m to 61 m
Micro UAV	2 kg to 5 Kg	1 m to 2 m
MAV	50 g to 2 Kg	15 cm to 1 m
NAV	3 g to 50 g	2.5 cm to 15 cm

V. CONCLUSIONS

This paper discussed about the different types &classifications of drones such as unmanned air vehicles, micro, Nano, pico and smart dust. To make it more clear each and every type of drones' key points were addressed in detail. A tabular representation is used to show the highlights of each and every drone. As we aware the drones are used to carry out many applications specifically civil and military. Those missions also elaborately expanded with its appropriate values. Of course the applications are also listed out in the form of flow chart with appropriate examples. The design methods and challengesare alsospotlighted.The factors, Configuration and design methodology are the two processes involved in the design processof Drones.With these inputs the pros and cons of drones are also generalized. Since Multi drones are more popular than single drone, the flying adhoc network is used to represent the connection of multi drones as a start. Finally Wireless communication scheme with a proper routing protocol which ensures proper coordination among the drones and improves the network performance is to be proposed in future

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