UAV Network and Communication in Modern Application

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Introduction to UAV

- Unmanned Aerial Vehicle (UAV) is an aerial vehicle that can be piloted remotely or flown autonomously based on preprogrammed flight plans , and powered by battery.

- The application scenario of UAVs has evolved in the past few decades, from specific military applications to civilian domain .In recent times, ad hoc networks deploying UAVs have gained scientific importance.

System Model of UAV

Drone like **quad – copters** fly at **low altitude with Sensor**, sometime **Constant** Attitude

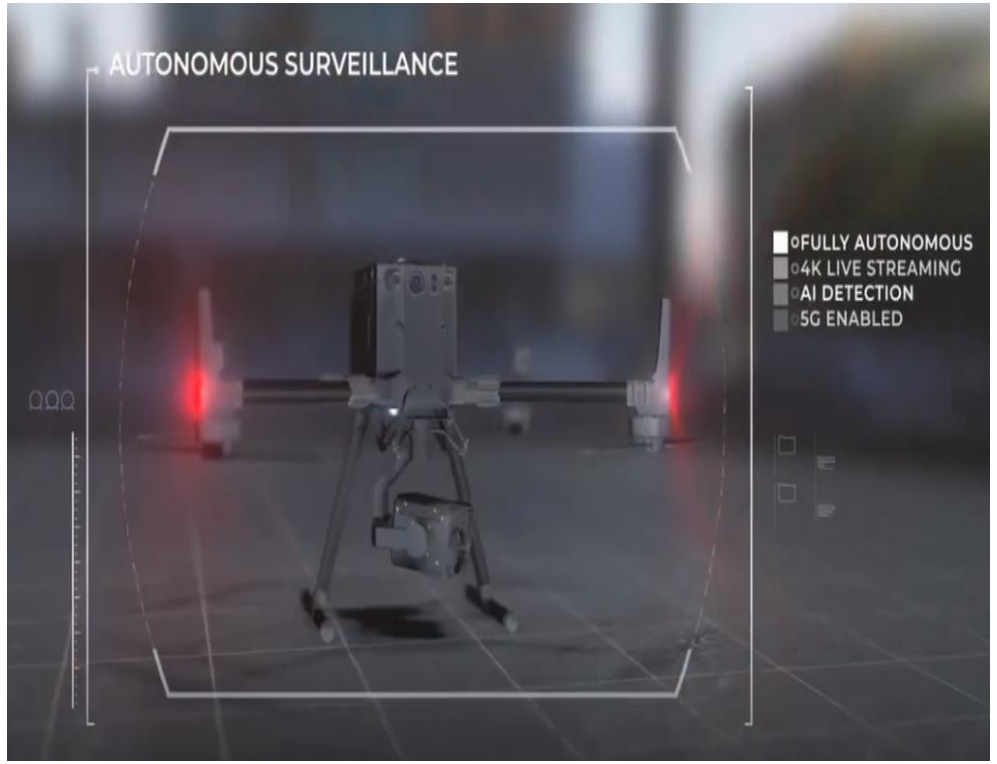
Drone equipped with **GPS, IMU** and **Digital map** to obtain its current geographical **position and velocity**

Drone equipped with communication system transmitter / receiver that use **IEEE 802.11 p** wireless interface with large **transmission range 300-500 meters**

Drone equipped with **re-chargeable batteries** to provide **energy for Camera to capture Data or live stream**

UAV Concepts

- ❑ Routing & Data Transmission
  - 4K Video live streaming, HD Camera
  - Routing Data with Minimum Latency
- ❑ Communication of UAV
- Infrastructure like 5G Network
- Non- Infrastructure such as Ad Hoc Network
- ❑ Process & Programming
- (Image processing, AI Detection, Algorithms)
- Programing like C++ , Python.
- ❑Control of UAV
  - Flight Control
  - Computer Control /Base Station



Single- UAV & M-UAV

- UAV networks may be categorized into single-UAV and multi-UAVs as illustrated in Figure below .

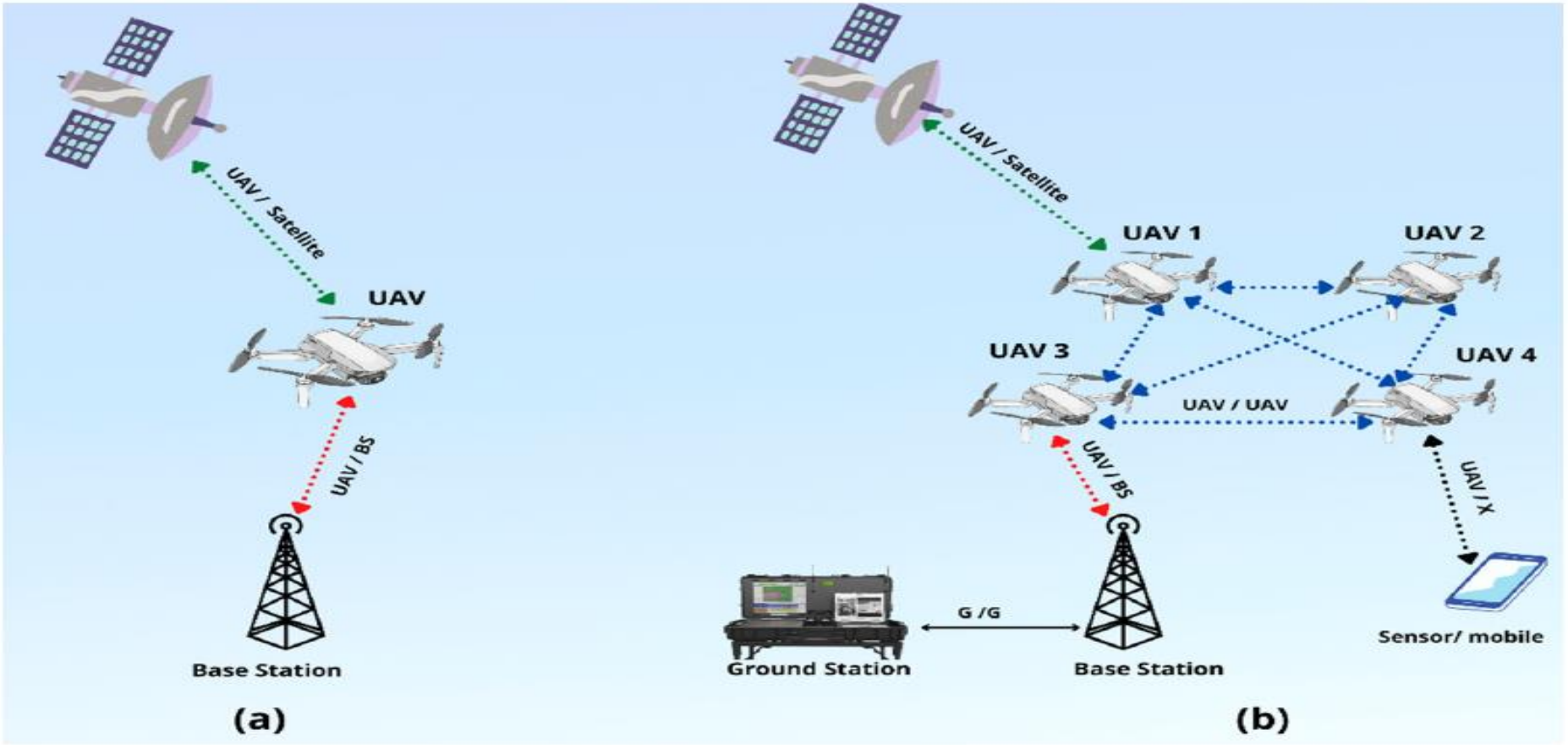


Figure 2. (a) Single-UAV network; (b) multi-UAV network.

Application Area of UAV

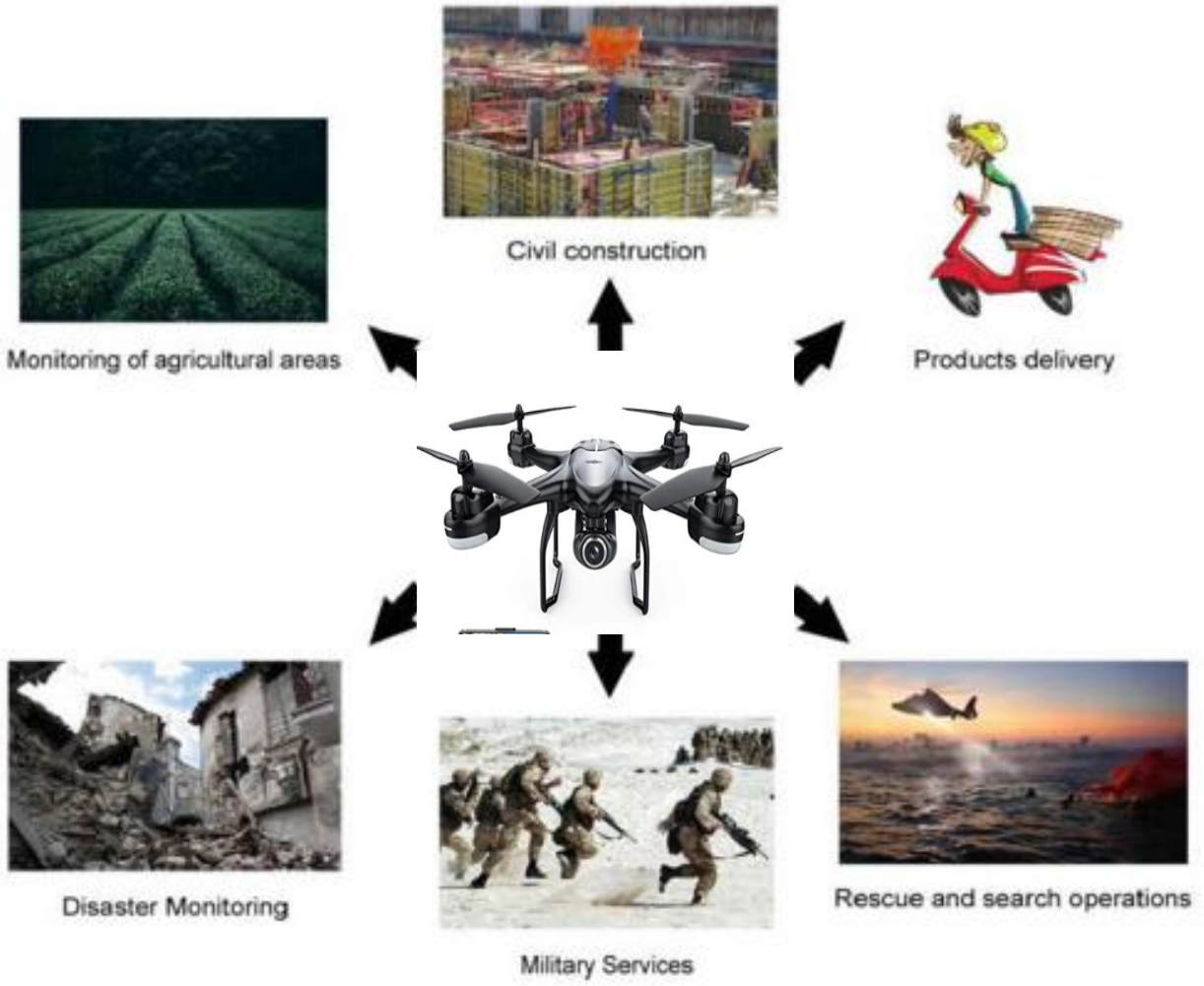
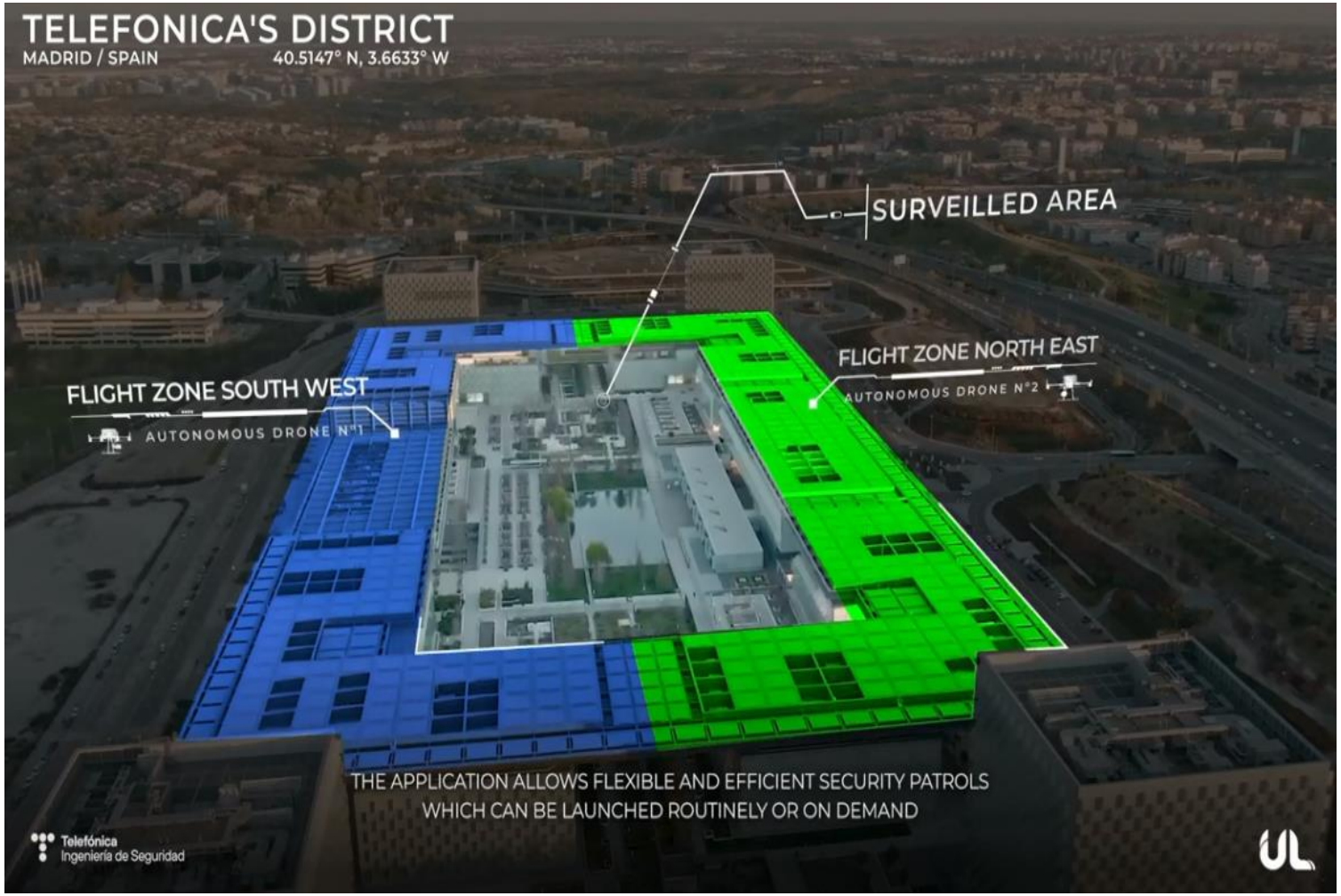
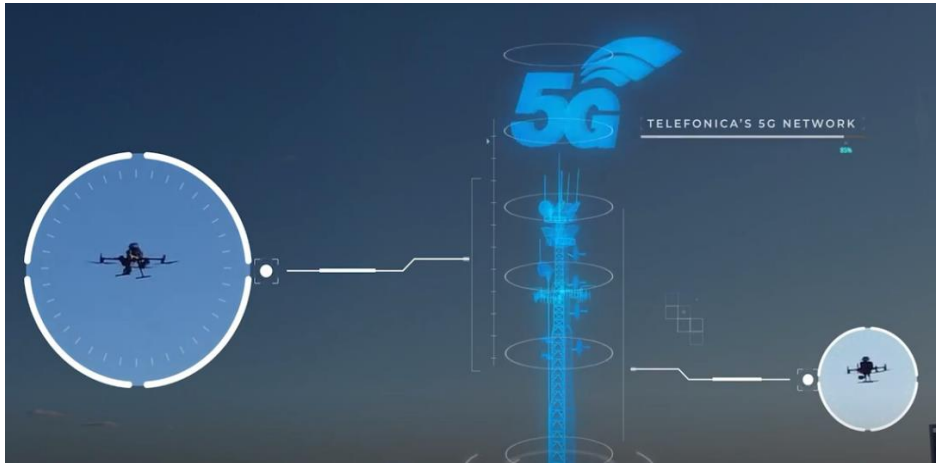
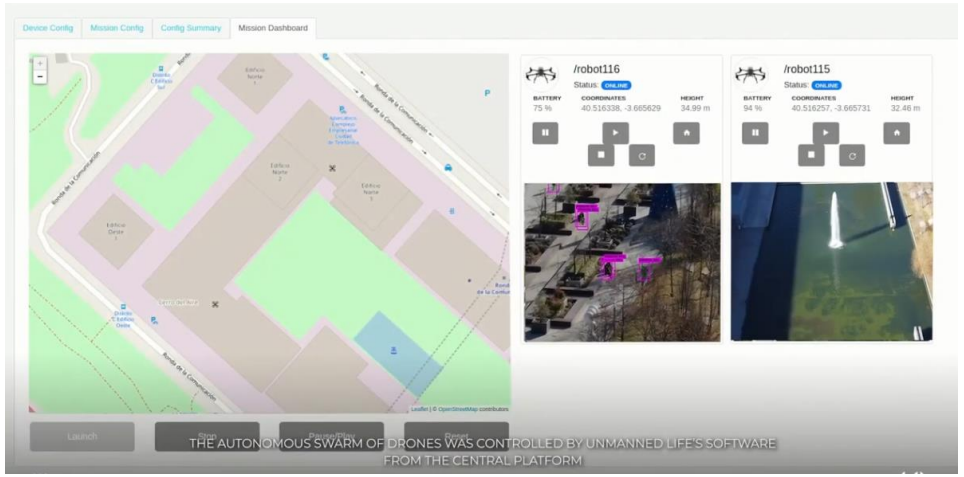


Fig. 1. Applications of FANET

Application of M-UAV : Surveillance



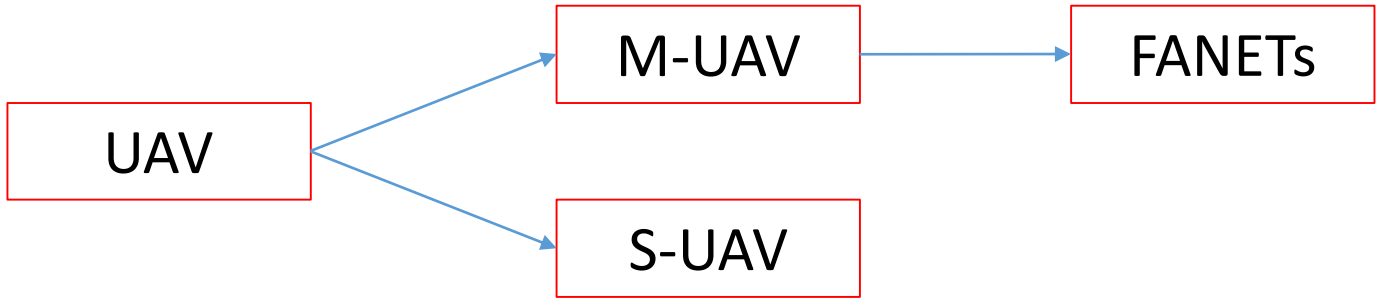




UAV Ad Hoc Network

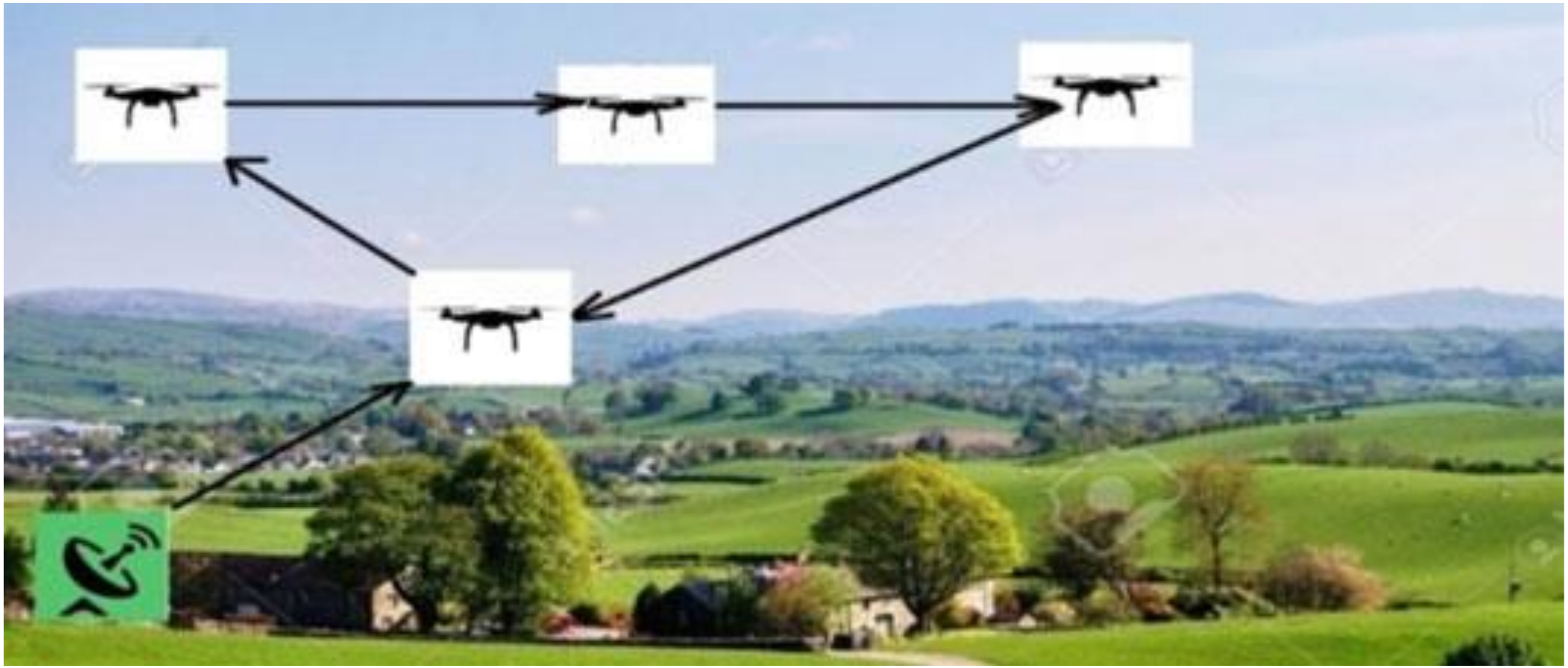
- Ad hoc network is a network which does not have a fixed infrastructure and each node in the network is dynamic and can move from one place to another limited by the coverage area of the network.

- The possibility of extending the wireless coverage, improving the overall capacity and enabling network auto-configuration with no infrastructure support has sparked the idea of multi-hop wireless networks such as the flying ad hoc networks(FANETs)



FANET application scenario

In FANETS, one of the UAVs is directly linked to the infrastructure, whereas the rest of the UAVs in the swarm has multi-hop communication in which each node acts as hop count or a relay



Application Area of FANETs

- FANETs are utilized for a range of military purposes, including reconnaissance and secure communication protocol in military operations .

- Further, they can be employed in civil applications such as relief operations in disaster environments, search and rescue , surveillance and monitoring , video surveillance mission in smart cities , and civil engineering structures.

challenges in the FANETs communication

- **Node Mobility**: The speed of UAVs ranges from 30 to 45 m/s, which pose a serious challenge in terms of maintaining data link and coverage quality. The topology change infuses key constraint on communication on the account of high node mobility.

challenges in the FANETs communication

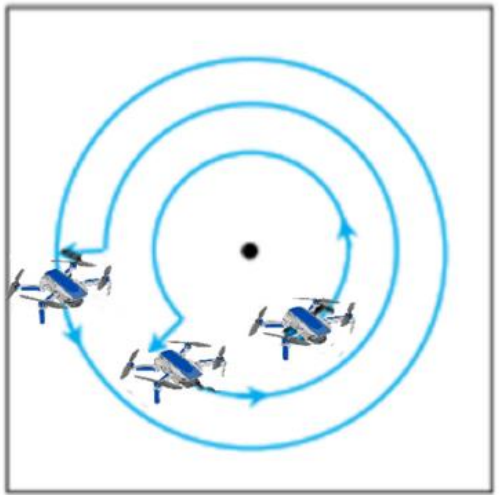
- **Geographical and Environmental Constraints**: Radio signal depends on the terrestrial environment such as the presence of high-rise buildings, mountains, or ravines.

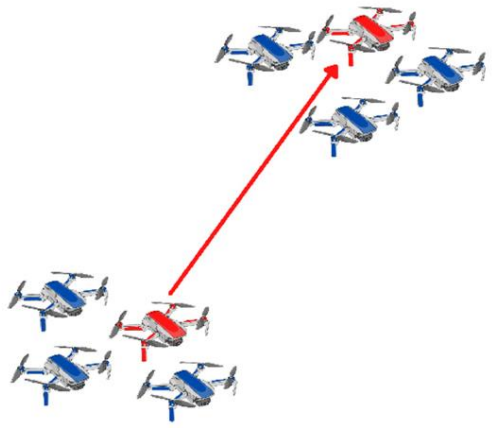
challenges in the FANETs communication

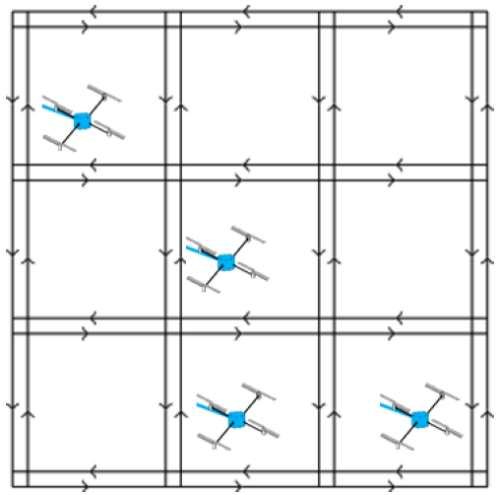
- **Low Latency and Sufficient Bandwidth Availability**: Latency is the delay in the packet data transmission among the dynamic nodes. FANET protocol must satisfy bandwidth capacity requirement so that latency is low- and high-resolution real-time images and videos are communicated .

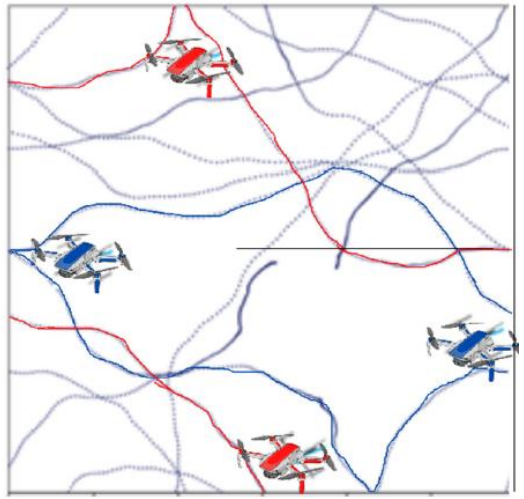
challenges in the FANETs communication

- **Select of Suitable 3D Mobility Models**: The mobility model describes the motions of UAVs in a specific region over time, including changes in speed, direction, and acceleration. Due to their mobility, UAVs may be tailored to the specific needs of an application, leading to better performance and flexibility.









Publication of UAVs

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Implementation of RWP and Gauss Markov Mobility Model for Multi-UAV Networks in Search and Rescue Environment

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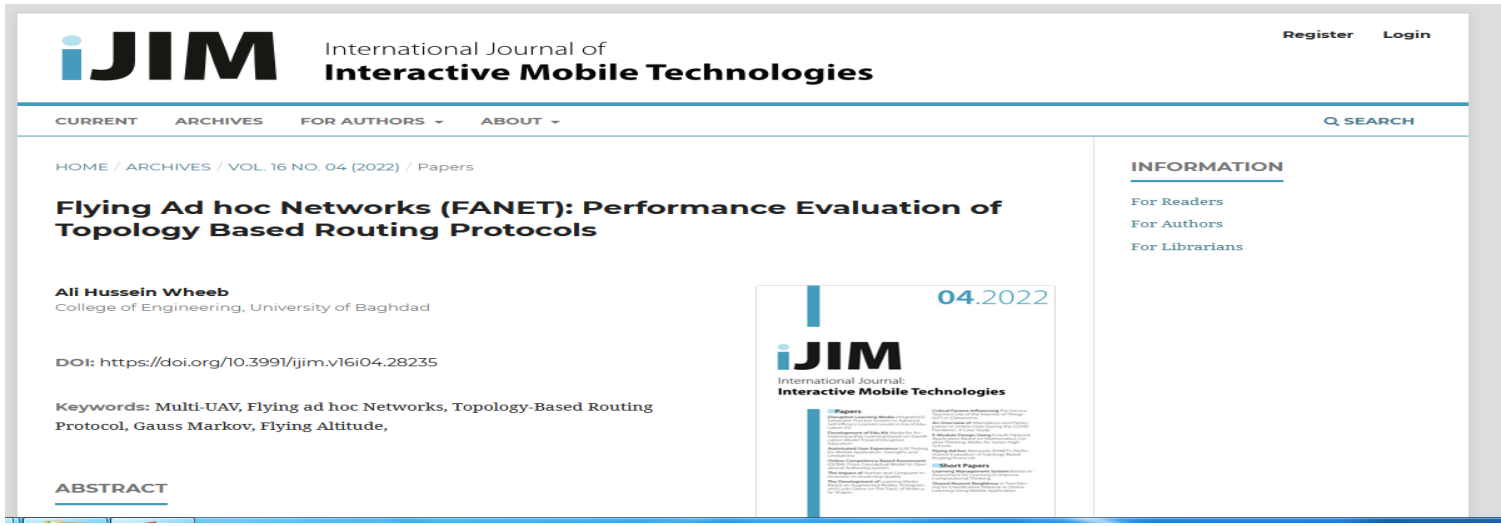
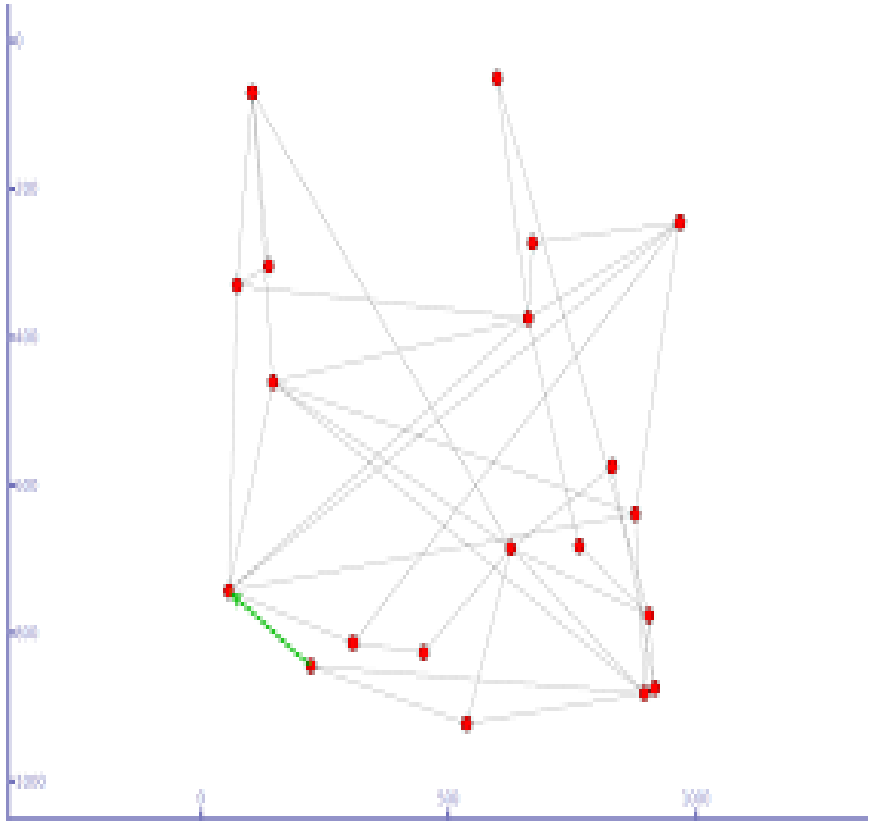


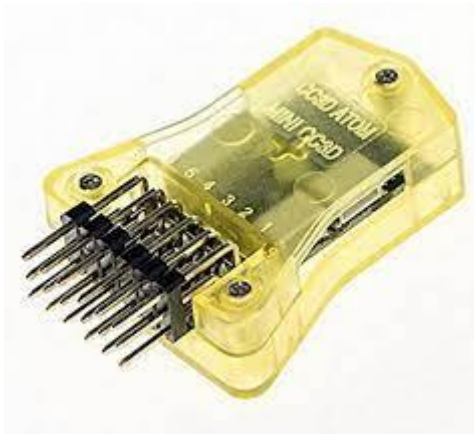
Simulation of UAVs

	A	B	C
1	Parameter	Value	Notes
2	Application	Search and Rescue (SAR)	
3	Routing Protocol	AODV (Reactive)	
4	No of sink node	20 flow	
5	transmission power	7.5	
6	No of mini-UAVs	50 (uav/sink =40-50%)	Manet/sink = 20%
7	simulation time	300 (first 100 search)	
8	Application rate	2Kbps	
9	MAC & Phy rate	11Mbps	
10	Packet size	1024 byte (Image/vedio)	
11	propagation model	Free space path loss	
12	Simulation Area	3km *1km	
13	flying Altitude	60 -100 meter	
14	Mobility model	Gauss Markov	
15	flying speed	10-30 meter/sec	
16	step time	0.5 sec	
17	alpha	0.85	
18	result calculation	Python	
19	performance metrics	sent packet	
20		received packet	
21		loss packet	
22		packet delivery ratio	

Simulation of UAVs



Project of UAVs




THANK YOU
FOR LISTENING