IMPROVED PERFORMANCE OF ROUTING IN FANET USING CACHING TECHNIQUES

Vijay Vasanth Aroulanandam*
Assistant Professor
Networking and Communications Department
School of Computing
SRM Institute of Science & Technology
Kattankulathur - 603 203, Kancheepuram (D.t), Tamil Nadu, India
Email:a.vijayvasanth@gmail.com
(Corresponding Author)

Dr. Yamini Bhavani Shankar
Assistant Professor
Networking and Communications Department
School of Computing
SRM Institute of Science & Technology
Kattankulathur - 603 203, Kancheepuram (D.t), Tamil Nadu, India
Email: yamini.subagani@gmail.com

Shahul Hameed Chettali
Teaching Fellow
Department of Computer Technology
Anna University - MIT Campus
Chromepet, Chennai,Tamil Nadu, India.
Pincode- 600044.
Email : shahul@live.in

ABSTRACT

Flying Ad Hoc Network (FANET) is a recent and most advance networks in the communication field. FANET is a collection of Unmanned aerial vehicle (UAV) which used to make end to end communication between UAV node to another UAV node. Routing plays a vital role in making communication from one node to the other node .In recent trends , UAV nodes rapidly increases and struggle to maintain the quality of service during to end –end communication. Thus to overcome the drawback , this paper proposed Caching technique jointly with the routing algorithm to increase the performance and quality of the FANET. This paper relates with the comparsion of DSR and its comparative performance with the different caching techniques. 390

Keywords: *FANET, DSR , Routing algorithm, UAV, RAMP, ad hoc networks.*

DOI Number: 10.14704/nq.2022.20.2.NQ22330 **NeuroQuantology 2022; 20(2):390-400**

I.INTRODUCTION

FANET is a derived network from basic adhoc networks which is constituted with UAVs. Initially the process dealing with flying mode are carried out with drone and the drone is now replaced with UAVs. The working of UAVs involves in executing a specific task using sub UAV nodes. The communication between the UAV nodes can be a single hop or Multiple hop.

Successive transmission of data can be done in both the hops. In regular modes , UAV s can also be operated on single hop strategy in processing a specific task.UAV are commonly automated systems that is being operated by a microcontroller chip for processing the input commands and uses transceivers for output related process.[1-9]

FANET are used in military fields, medical fields and agricultural fields. In addition,it is also used in monitoring purpose. FANET can be operated by a controller at the ground level or it can be operated independently .Initially FANET is being worked out with single UAV and has communication grows the single UAV is attached with a group of multiple UAV to execute the task.

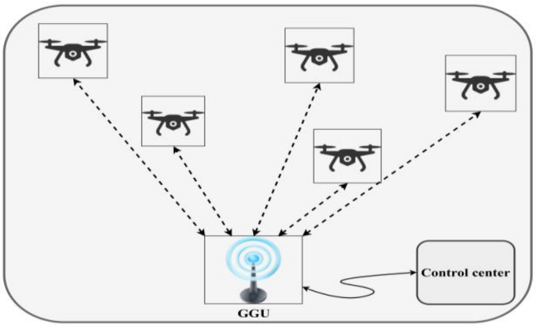


Figure 1.1: Basic Structure of FANET

In a multiple UAV system, any of the node gets failed , all the other nodes interconnected to the fail nodes will find an alternate path and proceed with the communication assigned .[11,14,17]UAV nodes are basically characterized by ad hoc networks and centralized network and each group is considered as separate group.[10]

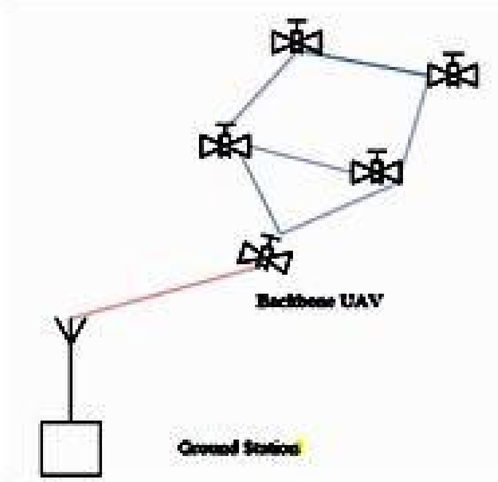


Figure 1.2:Unmanned Aerial Vehicle Ad hoc Networks

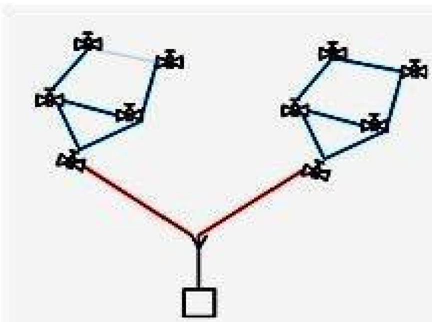


Figure 1.3: Multihop UAV ad hoc Networks

The routing process of UAV are likely to be similar and has four major divisions.Topology aware routing , cluster –based routing , beaconless opportunistic routing and position aware routing.The advantages of FANET is to identify and prioritize the node based on effective parameters and has a wide range to work with as hybrid network scenarios.[23-26]

II. RELATED WORKS

A number of researches have been proposed by researchers for improving QoS service in FANET. A detailed survey has been carried out to identify the various research articles available in the literature in all the categories of improving QoS through FANET routing schemes, and to do the analysis of the major contributions and its advantages. Following are the literature applied for assessment of the state-of-art work on Quality development.[10-16].

FANET holds different routing schemes based on its maintenance of routing process and topology. FANET nodes are the gathering of Multi-hop wireless nodes that communicates with each other by communication links. This communication links often lead to error due to the mobility of nodes, interference[18] and infrastructure less environment. Routing in FANET plays a major role in effective communication between the UAV nodes for data transmission Each routing protocol has been designed to tackle different fault that arises in the principles of dynamic topology. [22]

In this paper [1], it list out the different protocols that is suitable for FANET .Among all other protocols sketched for FANET , HWMP serves as a best in overtaking OLSR protocols at all aspects and the paper also adds different architecture suits for the FANET. Here HWMP is shown as a best protocol in working out with FANET communication process.AODV and DSDV are the two protocols shows slight improvement in the routing process and efficient performance in the FANET Communication process.[3]

In this paper [2], all the caching technologies with the advanced- modified version of DSR protocols such as RAMP,MRAMP are being analyzed with different caching techniques. The results shows that RAMP and MRAMP shows more performance than DSR .The protocols are compared with the routing parameters such as packet delivery ratio , power consumption, packet loss etc., and proved that caching technique is an added advantage to any routing protocol in increasing the performance.[23]

In the paper [7], proposed a modified version of AODV routing protocol for route discovery mechanism and real-time transmission of data. The proposed protocol increases the QoS without creating a negative impact on data traffic and also assigns more bandwidth for RT traffic. It reduces the transmission delay of data packets without affecting the traffic. The proposed protocol shows a greater impact on throughput and reduces delay at a higher level. The modified AODV protocol is most suited to moderate density networks.[19]

III.PROPOSED WORK

The proposed deals with testing RRAMP with the caching techniques in FANET. The parameters includes for calculation are as follows:

3.1 Refined RAMP Protocol

4

In this paper a hybrid approach is proposed , Cooperative caching together with the genetic search algorithm is made to work along with the RAMP and further discussion this combined category is termed as RRAMP (Refined RAMP = RAMP+ Genetic algorithm + Cooperative caching mechanisms). The genetic algorithm which is more effective in searching of node in MANET is being adopted to find the shortest path between the neighbouring nodes and a successive process cooperative cache techniques is applied is to search for the relevant data in the cache of the neighboring node.

5

i. Algorithm Specifications

a. Genetic search algorithm

i. Algorithm Sequence

Step 1: The defined limits are set for the Shortest Path route.

Step 2: Random values are generated

between limits.

Step 3: The values of generated routes are put into the objective function

Step 4: The fitness evaluation is done for the various routes

```
fmax (n, 1) = max (fx (n, 1))
fmin(n,1) = min(fx(n,1)
for i=1:z
ft(i,1) = (fmax(n,1) - fmin(n,1)) –
fx(n,1);
ftb = mean (ft);
for i=1:z rl (i, 1) = ft (i, 1)/ftb;
end
```

Step 5: The best fit is calculated based on the equation above.

Step 6: Selection based on the roulette wheel concept is done, the values providing the best fit being given a higher percentage on the wheel area so that values providing a better fit have a higher probability of producing an offspring.

Step 7: Crossover is performed on strings using midpoint crossover. Crossover provides incorporation of extra characteristics in the offsprings produced.

Step 8: Mutation is done if consecutive iteration values are the same.

Step 9 :The new routes that satisfy the objective of minimization, and related parameters are plotted. Where : fx is the fitness value; ft=normalized fx

ii. Pseudocode

START
Generate the initial population
Compute fitness

REPEAT
Selection
Crossover
Mutation
Compute fitness

UNTIL population has converged
STOP

b. Cooperative Cache Sequences

i. Assumptions

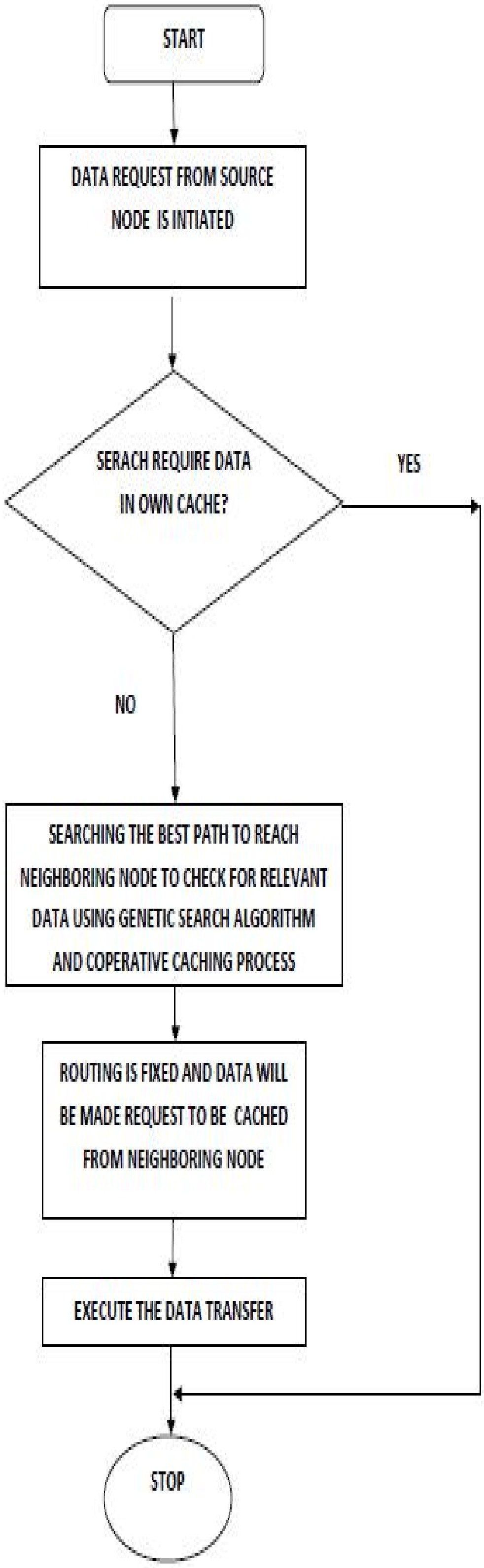
1. All nodes are cooperative

2. Each node when it carries out transaction with another node, holds a copy of transacted data in its cache.

ii. Algorithm Sequence

Step 1: The source nodes looks for the data in its own cache. If the data is present in its own Cache, then the communication will not be initialized.

Step 2: In case if the relevant information is not in the own cache, the source node searches for its neighbours which are nearby based on the communication range.



*e*ISSN 1303-5150

Step 3: The source nodes node searches the neighbouring node by a defined search algorithm it adopts.

Step 4: Upon receiving an Interest from the source node, a node searches its cache looking for a hit. If so, the content is replied toward the requesting node in a similar fashion.

Step 5: If the content is not found in the neighbouring node of the first sequence, the Interest will be forwarded to the neighbours and then it will be store moved and forwarded.

Step 6: The procedure is repeated until the relevant resource is detected. In case if the information is not available in the entire paths, the source node will create the information and store the copy in its own cache and send the cached data information to its neighbour. The overall process is given in figure 3.1

IV. SIMULATION ENVIRONMENT

A.SIMULATION METRICS

1. Packet Delivery Ratio

Packet delivery ratio is termed as the number of data packets forwarded from source node to destination node to the total number ofpackets received at the destination node.

PDR = (Total Packets delivered at destination / Packets received from the source node)

2. End-to-End delay

End-to-End delay is defined as the ratio between the estimated time for delivery of packets at the destination

Fi B. SIMULATION ENVIRONMENT IP

Simulation parameter	Values
Simulator and version	Ns-all-in-one (version2.35)
Channel Type	Wireless
Protocols Used	DSR,RAMP,RRAMP
Number of UAVs	100
Type of Traffic	CBR
Mac Layer Protocol	802.11

node to the overall arrived time of the packets at the destination node
End-to-End delay = ∑ (Received Time of – Sent time) / ∑ (Number of packets)

3. **Routing Overhead** Routing overhead is defined as the number of packets generated to the total number of packets received at the destination.
Routing Overhead = ∑ (Number of Packets generated) / ∑ (Total Number of packets delivered)
4. **Packet Drop**
Packet drop is defined as the ratio between the numbers of packets sent to the number of packets received.
Packet drop = (Packet sent from the source) / (Packet received at the destination)
5. **Energy Consumption**
Energy Consumption is said to be the ratio between the total energy consumption to the number of nodes.
Energy Consumption: Total energy Consumed / Number of nodes

Table 4.1- Simulation Parameters

C.SIMULATION RESULTS

The corresponding values obtained for simulation metrics using NS2 are listed below for the protocols DSR and its higher versions namely RRAMP to improve the QoS in FANET.the selected parameters are tested with the Genetic Search algorithm and cooperative caching algorithms. The techniques has been tested with QoS parameters and the result has been obtained optimistically

(i) Packet Delivery Ratio (%)

The PDR ratio shows more effective when comparing with DSR and RRAMP.

Table 4.2 – Experimental values for PDR

No of Nodes	10	30	50	70	100
DSR	92.21	84.65	78.97	69.4	56.07
RAMP	96.12	89.64	81.56	74.19	64.58
RRAMP	96.09	88.54	84.26	79.02	65.43

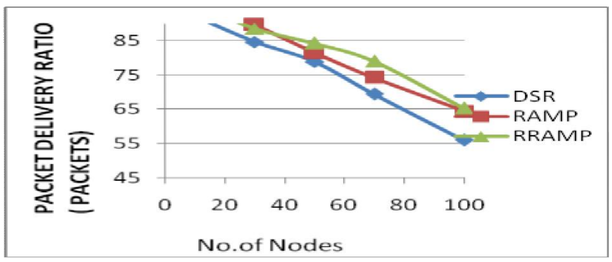


Figure 4.1 : Packet Delivery Ratio graph

(ii) End To End Delay(Milliseconds)

The End to End delay parameter is calculated and the feasible results obtained are tabulated and sketched.

No of Nodes	10	30	50	70	100
DSR	20.07	30.01	40.0	49.01	62.05
RAMP	11.03	17.09	24	29.04	42
RRAMP	5.07	7.1	8.09	12.08	18.05

Table 4.3 :Experimental Values for End to End Delay

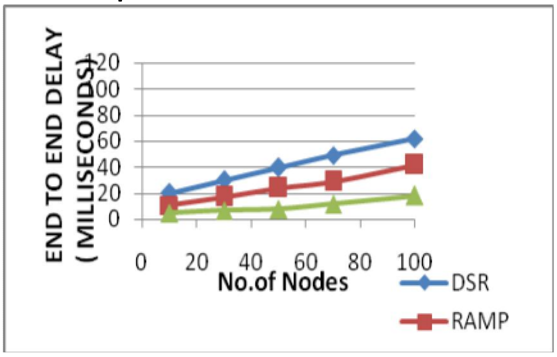


Figure 4.2: End To End Delay graph

(iii) Routing over head

Major issues in routing overhead is reduced at the least level in the modified versions is known from the simulation results.

No of Nodes	10	30	50	70	100
DSR	600	2000	4500	7500	11000
RAMP	300	1500	3400	6500	10000
RRAMP	200	1200	2900	5800	8500

Table 4.4 :Experimental Values for Routing Overhead

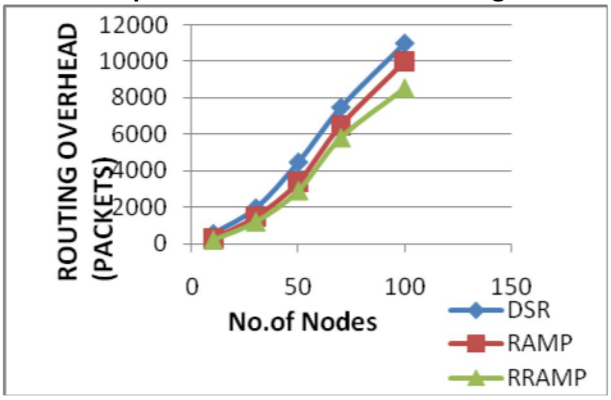


Figure 4.3:Routing Overhead graph

(iv).Packet drop

Packet drop gives better result when comparing DSR with its advanced versions in dropping of packets.

397

Table 4.5 :Experimental Values for Packet drop

No of Nodes	10	30	50	70	100
DSR	10.06	17.07	12	21.08	16.09
RAMP	6.02	13.08	7.09	19.05	14.09
RRAMP	3.08	10.06	5.03	15.01	12.07

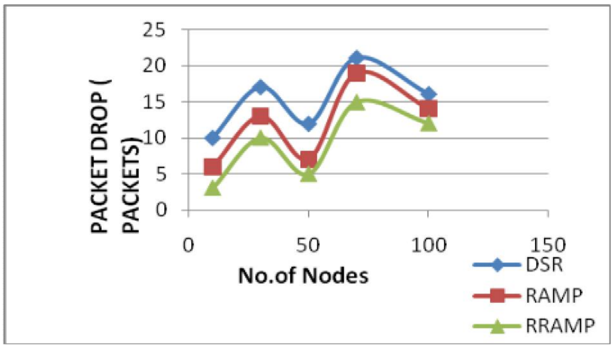


Figure 4.4: Packet drop graph

(v). Energy Consumption

Much amount of energy are consumed when caching techniques is applied along with the advanced version of DSR protocol in FANET

No of Nodes	10	30	50	70	100
DSR	150.1	148	134	122.1	106.1
RAMP	124.1	116	108.1	99.06	89.09
RRAMP	110.1	98.05	88.07	80.06	70.06

Table:4.6 Experimental Values for Energy Consumption

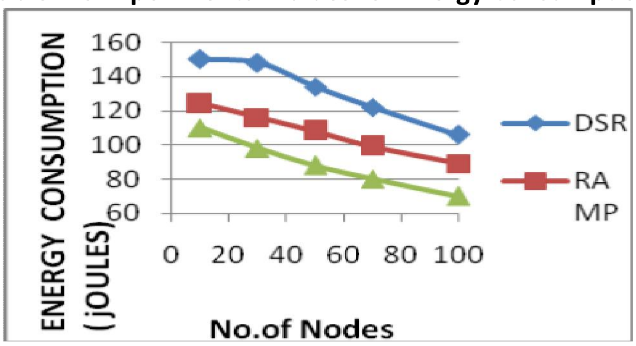


Figure 4.5: Energy consumption graph

V. CONCLUSION AND FUTURE ENHANCEMENTS

In this paper , an approach to increase the QoS of service along with the caching techniques and higher version of RAMP(RRAMP) is proposed. The simulation result gives an effective result in bring out the quality in routing mechanisms. This idea behind this paper better works with FANET routing mechanisms and this routing mechanisms can also be further developed with the hybrid protocol schemes. Working out hybrid routing schemes will give much more better than the quality obtain from the reactive protocol i.e, DSR and its advanced versions.

REFERENCES

[1] M. A. Khan, A. Safi, I. M. Qureshi and I. U. Khan, "Flying ad- hoc networks (FANETs): A review of communication architectures and routing protocols," 2017 First International Conference on Latest trends in Electrical Engineering and Computing Technologies (INTELLECT), Karachi, 2017, pp. 1-9.

[2] K. Singh and Anil Kumar Verma, "Experimental analysis of AODV, DSDV and OLSR routing protocol for flying adhoc networks (FANETs)," 2015 IEEE International Conference on Electrical, Computer and Communication Technologies (ICECCT), Coimbatore, 2015, pp. 1-4.

[3] S. Rosati, K. Krużelecki, G. Heitz, D. Floreano and B. Rimoldi, "Dynamic Routing for Flying Ad Hoc Networks," in IEEE Transactions on Vehicular Technology, vol. 65, no. 3, pp. 1690-1700, March 2016.

[4] Morse, B.S.; Engh, C.H.; Goodrich, M.A. UAV video coverage quality maps and prioritized indexing for wilderness search and rescue. In Proceedings of the 5th ACM/IEEE international conference on Human-robot interaction, Osaka, Japan, 2–5 March 2010; pp. 227–234.

[5] M. H. Tareque, M. S. Hossain and M. Atiquzzaman, "On the routing in Flying Ad Hoc Networks," 2015 Federated Conference on Computer Science and Information Systems (FedCSIS), Lodz, 2015, pp. 1-9.

[6] Balamurugan P, Marimuthu K, Mummoorthy A, Viswabharathi," Consistent and Effective Energy Utilization of Node Model for Securing Data in Wireless Sensor Networks" International Journal of Grid and Utility Computing, INDERSCIENCE, Scopus (Elsevier), ISSN: 1741-8488,Vol.9, No.03,pp.220-227, 2018 (DOI: 10.1504/IJGUC.2018.093978)

[7] P. Balamurugan J Santhosh G.Arulkumaran M. Baskar and R.Velumani," Image Driven Multi Feature Plant Management with FDE Based Smart Agriculture with Improved Security in Wireless Sensor Networks" Wireless Personal Communications, Springer SCI, ISSN 0929-6212, Vol., Issue.,2021.(https://doi.org/10.1007/s11277-021-08710-x) (Impact Factor: 1.671)

[8] Prabakeran S, Dr T.Sethukarasi, "Optimal solution for malicious node detection and prevention using hybrid chaotic particle dragonfly swarm algorithm in VANETs", The Journal of Mobile Communication, Computation and Information - Wireless Networks (ISSN: 1022-0038 (Print) 1572-8196 (Online) 2020, Impact Factor 2.405 - Springer Publishers (SCI). DOI 10.1007/s11276-020-024

[9] S.Suseela,R.Eswari,S.Nickolas,M.Saravanan ,"QoS optimization through PBMR algorithm in multipath wireless multimedia sensor networks",Peer-to-Peer Networking and Applications(Springer),13,Pp.1248-1259,2020(https://doi.org/10.1007/s12083-019-00853-w)

[10] Defined Network Based Cooperative Scheme for Mitigation of DDoS Attacks", Journal of Computational and Theoretical Nanoscience (EISSN: 1546-1963 (Online)--Volume 15, Number 6/7 (June/July 2018))- doi:10.1166/jctn.2018.7440, pp 2221–2226.

[11] Prabakeran Saravanan, Dr T.Sethukarasi, Indumathi V, "Authentic Novel Trust Propagation Model With Deceptive Recommendation Penalty Scheme For DDoS Attacks", Journal of Computational and Theoretical Nanoscience (EISSN: 1546-1963 (Online)--Volume 15, Number 6/7 (June/July 2018))- doi:10.1166/jctn.2018.7474, pp 2383–2389.

[12] Clausen, T., Hansen, G., Christensen, L., & Behrmann, G. (2001, September). "The optimized link state routing protocol, evaluation through experiments and simulation". In IEEE Symposium on Wireless Personal Mobile Communications.

[13] Tareque, M.H.; Hossian, M.S.; Atiquzzaman, M. On the routing in Flying Ad Hoc Networks. In Proceedings of the 2015 Federated Conference on Computer Science and Information Systems (FedCSIS), Lodz, Poland, 13–16 September 2015.

[14] Han, Z.; Swindlehurst, A.L.; Liu, K.J.R. Optimization of MANET connectivity via smart deployment/movement of unmanned air

vehicles. *IEEE Trans. Veh. Technol.* **2009**, *58*, 3533–3546.

[15] To, L.; Bati, A.; Hilliard, D. Radar Cross Section measurements of small Unmanned Air Vehicle Systems in non-cooperative field environments. In Proceedings of the 2009 3rd European Conference on Antennas and Propagation, Berlin, Germany, 23–27 March 2009.

[16] Purohit, A.; Mokaya, F.; Zhang, P. Demo abstract: Collaborative indoor sensing with the SensorFly aerial sensor network. In Proceedings of the 2012 ACM/IEEE 11th International Conference on Information Processing in Sensor Networks (IPSN), Beijing, China, 16–20 April 2012.

[17] Barrado, C.; Messeguer, R.; Lopez, J.; Pastor, E.; Santamaria, E.; Royo, P. Wildfire monitoring using a mixed air-ground mobile network. *IEEE Pervasive Comput.* **2010**, *9*, 24-32. [CrossRef]

[18] Maza, I.; Caballero, F.; Capitán, J.; Martínez-de-Dios, J.R.; Ollero, A. Experimental Results in Multi-UAV Coordination for Disaster Management and Civil Security Applications. *J. Intell. Robot. Syst.* **2011**, *61*, 563–585.

[19] Semsch, E.; Jakob, M.; Pavlicek, D.; Pechoucek, M. Autonomous UAV surveillance in complex urban environments. In Proceedings of the 2009 IEEE/WIC/ACM International Joint Conference on Web Intelligence and Intelligent Agent Technology, Milan, Italy, 15–18 September 2009.

[20] Erdelj, M.; Natalizio, E.; Chowdhury, K.R.; Akyildiz, I.F. Help from the sky: leveraging UAVs for disaster management. *IEEE Pervasive Comput.* **2017**, *16*, 24–32.

[21] A. Vijay Vasanth, K.Venkatachalapathy, V.Ohm Prakash ,T.P.Latchoumi, Latha Parthiban, ,"An Efficient Cache Refreshing Policy to Improve QoS in MANET through RAMP",International Journal of Advances in Intelligent systems and Computing ,Springer book 2018.

[22] Megha N ,Dr.Mallikarjun B C ,"Performance evaluation of Routing protocols using FANET using Ns2",International Journal of Engineering research & Technology ,July 2020,pp-1128-1132.

[23] Narra, H., Cheng, Y., Cetinkaya, E. K., Rohrer, J. P., & Sterbenz,J. P. (2011, March). "Destination-sequenced distance vector (DSDV) routing protocol implementation in ns-3". In Proceedings of the 4th International ICST Conference on Simulation Tools and Techniques (pp. 439-446). ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering).

[24] Uragun, B. Energy Efficiency for Unmanned Aerial Vehicles In Proceedings of the 10th International Conference on Machine Learning and Applications and Workshops, Honolulu, HI, USA, 18–21 December 20

eISSN 1303-5150