# Comparative Analysis of Selected Routing Protocols for WLAN Based Wireless Sensor Networks (WSNs)

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***Abstract*— In this paper our main focus is on the performance evaluation of selected routing protocols in WLAN based Wireless Sensor Networks (WSNs). A comparative analysis of routing protocols such as Ad-hoc On-demand Distance Vector Routing System (AODV), Dynamic Source Routing (DSR) and Optimized Link State Routing (OLSR) is been evaluated with respect to different network parameters like network end to end delay ,load, and throughput in different scale of sensor network scenarios to analyses the best performing protocol. It has been observed that Simulation results indicate that OLSR gives minimum network load in all three scenarios while AODV gives best throughput in small scale network but in medium and large scale networks, DSR is better. So with respect to terms of delay, OLSR is more efficient in small and medium scale network while AODV is insignificant improved in large networks. Apart from this the concept of cooperative communication using WSN is also implemented and the outcome of the protocols and efficiency of sensors network and cost effective.**

Keywords— **WLAN, WSN, AODV, DSR, OLSR**

## Introduction

Its obvious that application of wireless sensors network has got its significant importance in every field of life from defense to medical and education.. Tin sensors network the sensors are called nodes and each node is connected to its neighbor node which communicate to send and receive data wirelessly.

Sensors of the same applications form to their groups which form to cluster of nodes. Sensors network may be of two types either static or actor sensors based upon the application.

Adhoc networking can be implemented using sensors networks but their some issues regarding sensors networks e.g. Security, best routing and power [1]. Routing has been a core challenge in ad-hoc networks for last few years. Traditional routing schemes are not applicable in sensor networks due to their small size, low battery life and ad-hoc nature. Low Battery Power is still a big constraint in ad-hoc networks especially in Wireless Local Area Networks (WLANs) based wireless sensor network. WLANs give higher data rate as compared to Bluetooth and ZigBee. A large number of routing protocols have been designed specifically for WSNs. These protocols gives different traffic rates, delay and throughput ranges. But due to mobility, ad-hoc nature, senor deployment and small size of nodes, these protocols are not able to fulfill the required performance in all scenarios. Keeping all these limitations in mind, there is a need to develop efficient routing algorithms in WLAN based sensor networks [2],[3]. Our objective is to perform performance analysis of routing protocols in WLAN based WSNs against three metrics; End to End delay, throughput ad network load in small, medium and large scale networks. The choice of best routing protocol in a network guarantees improved network performance and efficiency.

## II. Routing Protocols

### *A. Ad-hoc On-demand Distance Vector Routing System (AODV)*

Ad-hoc On-demand Distance Vector Routing System (AODV) is a reactive on request protocol. AODV is engineered for Mobile infrastructure-less networks. It employs the on-demand routing methodology for formations of route among network nodes. AODV satisfies unicast, multicast and broadcast routing. AODV routing protocol directs packets among mobile nodes of wireless ad-hoc network [7].

### *Dynamic Source Routing (DSR)*

Dynamic Source Routing (DSR) is a reactive on-request procedure and its root exists in source routing. In DSR, every network node moves in its own header, a whole and well organized list of network nodes over which packet crosses.

This protocol includes two main stages: route detection and route conservation. DSR does not include constant hello packets plus it is beacon less protocols [8].

### *C. Optimized Link State Routing (OLSR)*

Optimized Link State Routing (OLSR) is proactive table focused practice. OLSR has intermittent nature due to which it produces massive overhead. For compensation, Multipoint Relays (MPRs) are used by OLSR to minimize larger overhead. MRPs are chosen by every node as set of adjacent nodes and just these specific MRPS are liable to transmission of data. OLSR needs not to use consistent control communications distribution due to the fact that each node sends control communications intermittently. [8]

## III. Survey of Related Work

Out of a large number of applications, some demand higher data rates while some applications require minimum delay. Routing has been a major challenge in WLAN based Wireless sensor networks for past few years. Researchers have made a huge research on routing algorithms to resolve routing issues. A research was made on performance analysis of routing protocols by making use of NS2 simulator. AODV, DSR, DSDV and TORA had been simulated using NS2. DSDV takes better time delay when compared with AODV and TORA [3].

In [4], simulation was performed in Qualnet simulation platform. For low and moderate node density, AODV give excellent performance. In case of high density traffic, DSR and OLSR are best than AODV. Wireless sensor networks are such a wide research area that there is no single up to date survey on wireless sensor networks. Performance study of WSN‟s in small, medium and large networks against End-to-End (ETE) delay, load and data rate is accomplished in [5].

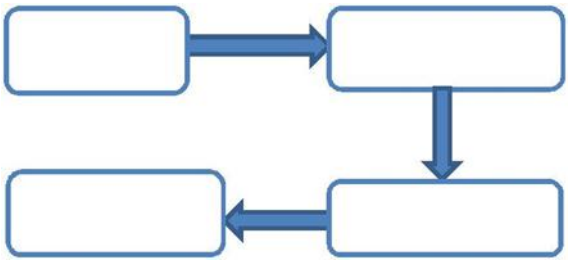
## IV. Research Problem & Main Contribution

The main problem is that the traditional routing protocols are not applicable in in WLAN based WSNs due to their low battery power, small size, low storage and processing power and ad-hoc nature.

The fundamental goal of this research is to explore performance evaluation of Reactive and Proactive routing protocols in WLAN based WSNs such as AODV, DSR and OLSR. Performance analysis of AODV, DSR and OLSR routing protocols will be made against three metrics named delay, network load and throughput in small, medium and large scale networks scenarios. The choice of best routing protocol would ensure better performance and good QoS.

## V. SIMULATION MODEL

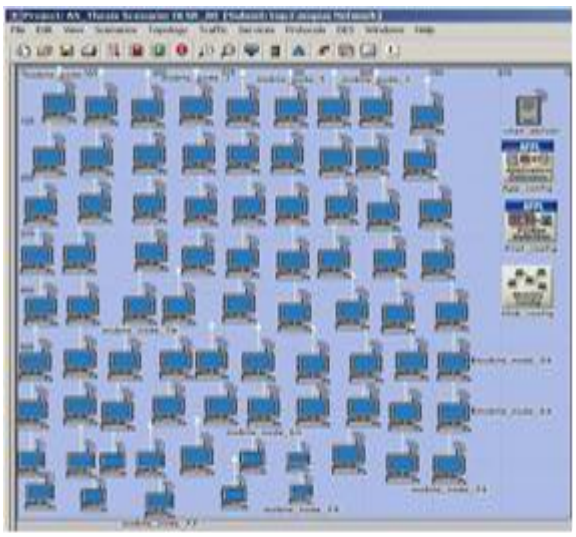
OPNET Modeler 14.5 network simulator is used to analyze AODV, DSR and OLSR routing protocols in WLAN based WSNs. These protocols are compatible in WLAN based WSNs and previous researches indicated that they have better performnace.Here, the performance of these protocols will be evaluated in small, medium and large scale network against delay, throughput and network load. Small scale network contains 20 nodes, medium scale with 40 nodes and large scale network takes 80 nodes. The simulation model is represented in Fig. 1. The general parameters for simulation scenarios are given in Table 1.



packet transfer time and broadcast delay plus other delays at route discovery and conservation. The quantity of data transmission from source to destination network node in a given specified amount of time. It is dignified in byte/sec. Network load (NL) shows net load which indicates in bits per second. Work load is sometimes also called as Network Congestion. When traffic load exceeds than link capacity then it is almost impossible for network to handle the traffic thus creating congestion in the network.

| Simulation Parameters | Values |
|---|---|
| No. of Nodes | 20, 40, 80 |
| Simulation Time | 120 sec. |
| Simulation Area | 1000 $m^2$ |
| Data Rate of nodes | 11 Mbps |
| Traffic | FTP (High Load) |
| Routing Protocols | AODV, DSR and OLSR |

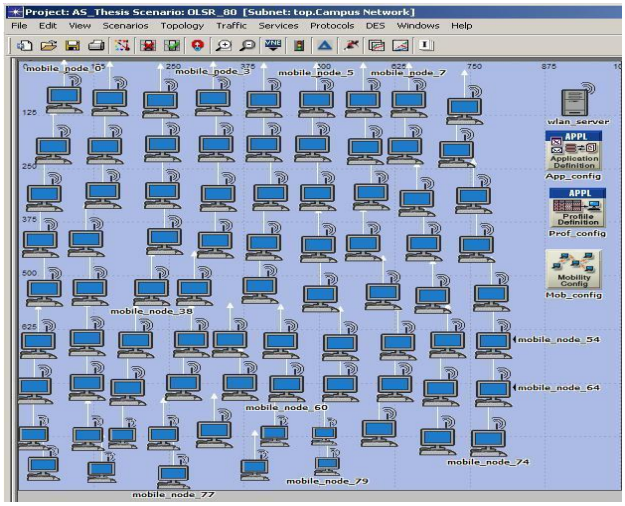
Now three network metrics are defined; End-to-End delay, throughput and network load. ETE delay is described by way of time engaged by an envelope to be communicated through a network from source to destination. It comprises retransmission delays on Media Access layer (MAC), In our simulations, there sensor networks are considered, firstly in a small scale network, 20 nodes are selected with one stationary WLAN server. These nodes are interconnected in star topology. Area of the network is 1000 x 1000 meters. IPv4 scheme is applied to entirely nodes and File Transfer Protocol is used as great traffic load. Each WLAN node has data rate of 11 Mbps. Similarly, a medium scale network is with 40 nodes and large scale networks is consisted of 80 nodes. Fig. 2 depicts a large scale WSN model for 80 nodes. All the remaining simulation parameters are same for these two networks.

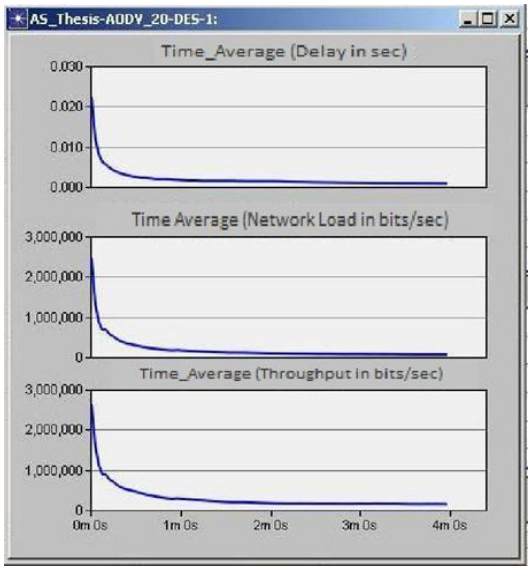


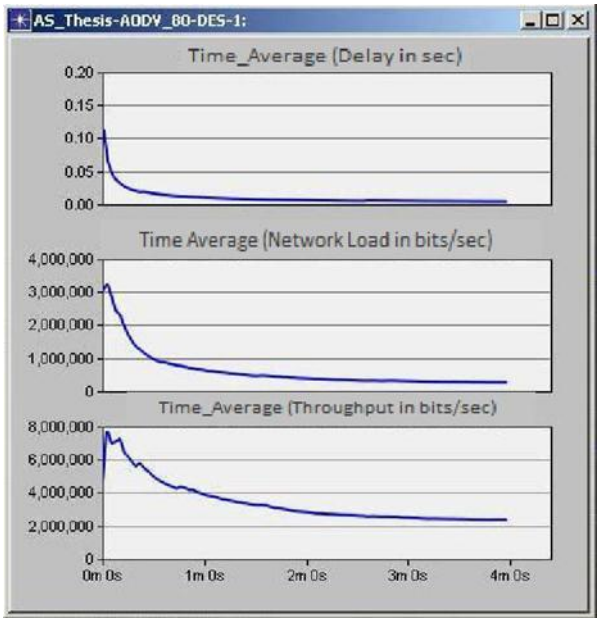
## VI. SIMULATION RESULTS

After running simulations, the following results are obtained. Fig. 3,4 and 5 disputes simulation results of delay, network load and throughput for AODV in small, medium and large scale networks, respectively. Delay is represented in seconds while throughput and network load in bits per seconds.

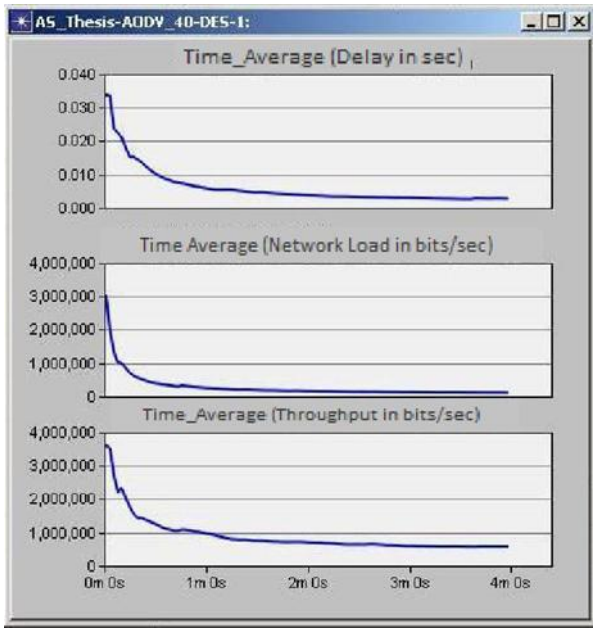
| Nodes | Parameters | AODV | DSR | OLSR |
|---|---|---|---|---|
| 20 | Delay (sec) | 0.020 | 0.024 | 0.011 |
| | Network Load (Kbps) | 2500 | 1700 | 1300 |
| | Throughput (Kbps) | 2800 | 2000 | 1500 |
| 40 | Delay (sec) | 0.033 | 0.060 | 0.013 |
| | Network Load (Kbps) | 3000 | 3000 | 2000 |
| | Throughput (Kbps) | 3700 | 4200 | 3000 |
| 80 | Delay (sec) | 0.10 | 0.17 | 0.015 |
| | Network Load (Kbps) | 3100 | 2900 | 2800 |
| | Throughput (Kbps) | 6200 | 13000 | 11000 |

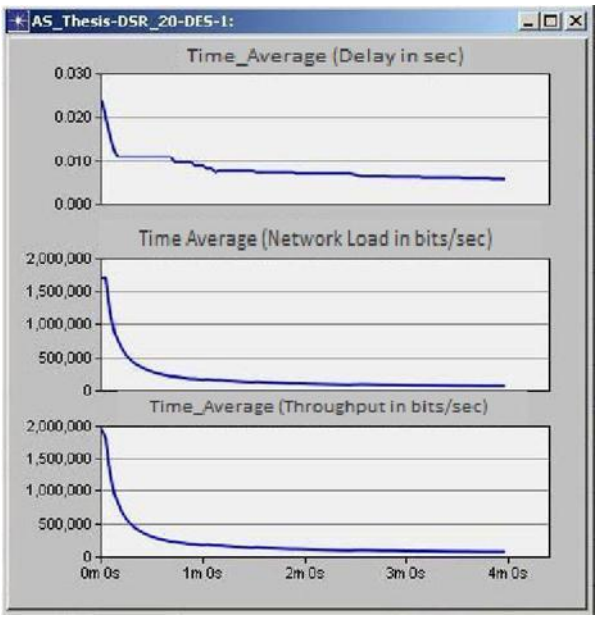


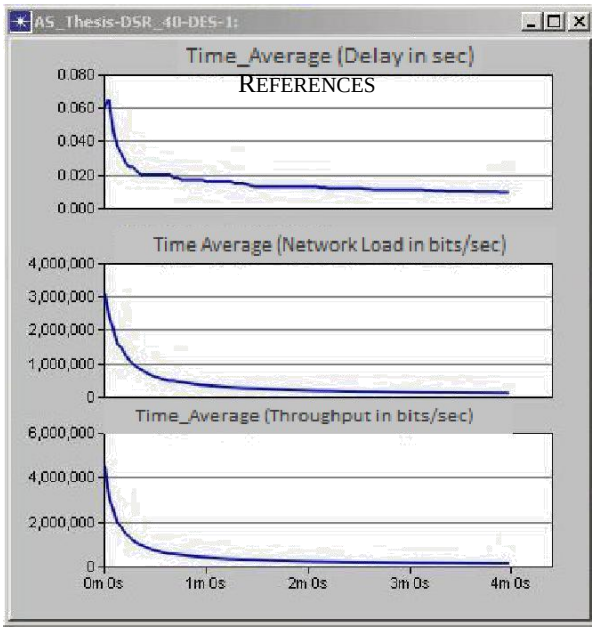


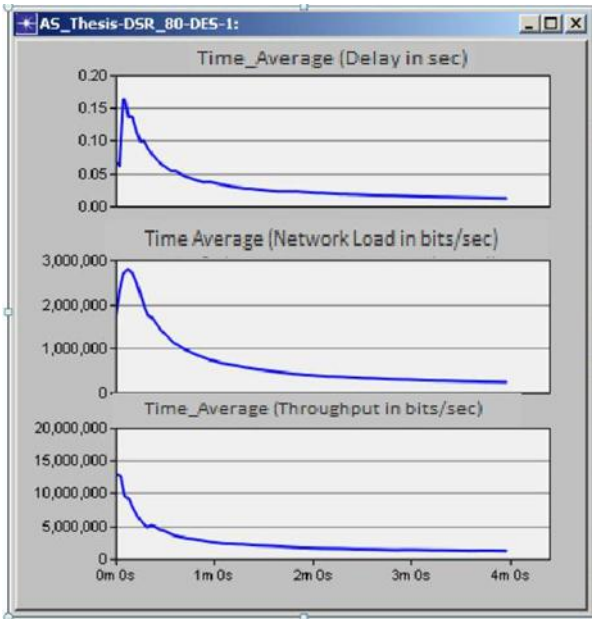




The results for delay, network load and throughput for DSR can be observed in Fig. 6, 7 and 8 when it is implemented in all the three previous scenarios.



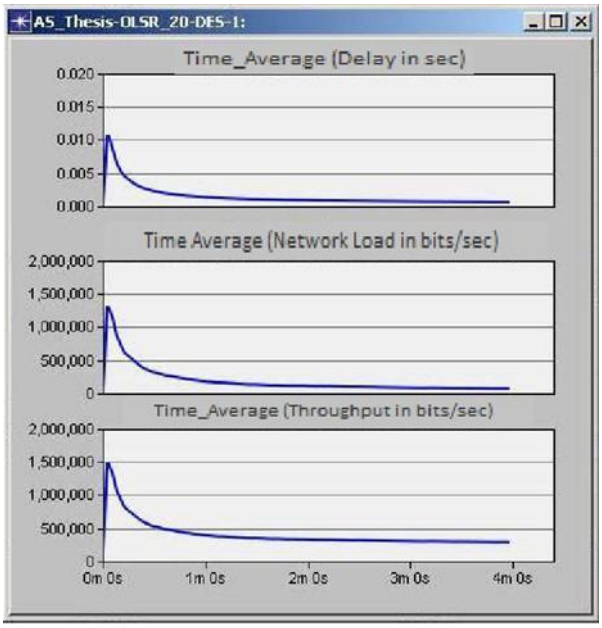



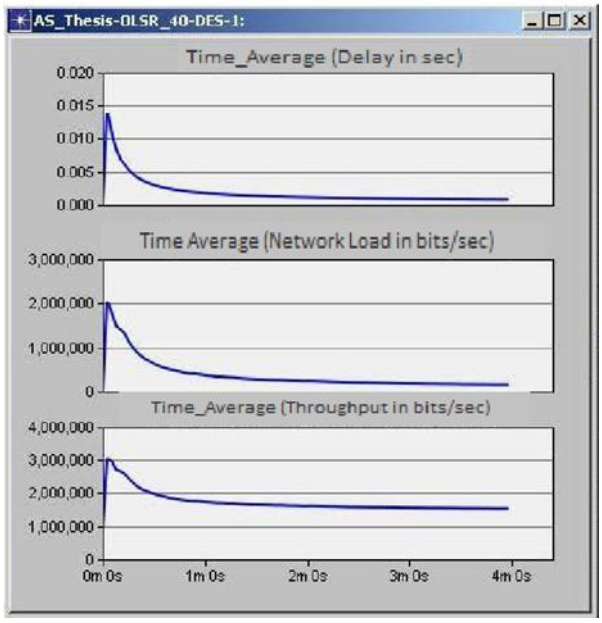


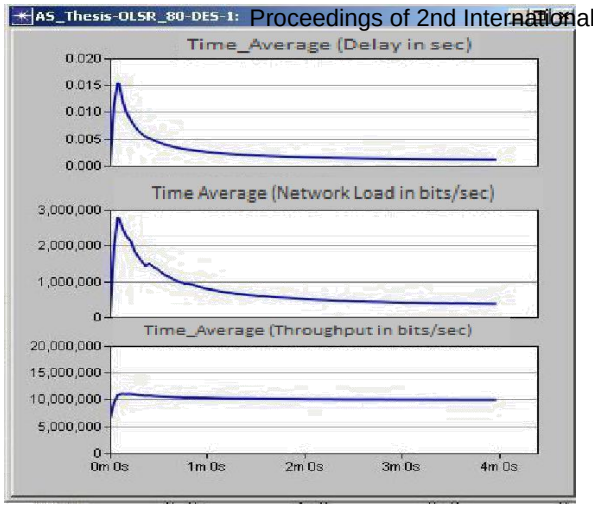




## REFERENCES

Similarly, OLSR is implemented in all the three experimental scenarios. Fig. 9 is detecting results for the three observed parameters for small scale network. The simulation results for medium scale network are shown in fig. 10 while fig. 11 is representing the outputs for large scale network.






## VII. CONCLUSION

The entire results of small, medium and large scale networks are mentioned below in table 2. It is concluded from the table that in terms of delay, the efficiency of OLSR is more than 100% in small and medium scale network as compared to the other two protocols while AODV is significantly (>50%) better in large networks. In case of network load, OLSR gives minimum load in all three scenarios. However, AODV gives best throughput in small scale network which is 40% more than DSR and 86% higher than OLSR. DSR is better than AODV and OLSR by a factor of 13% and 40% respectively, in medium scale network. Similarly, in large scale network it is better by a margin of 47% and 18%.

In future work, similar performance comparison of routing protocols can be made by changing the deployment scenario of the sensor nodes. In WSNs, the deployment and arrangement of sensor nodes is variable so it would be of significant concern to study that aspect of these networks.

## REFERENCES

[1] Akyildiz, I.F. et al., 2002. Wireless sensor networks: a survey. Computer Networks, 38(4), pp.393–422. Available at: http://www.sciencedirect.com/science/article/pii/S1389128601003024.

[2] B.A. Bakr, L. Lilien, "LEACH-SM: A protocol for extending wireless sensor network lifetime by management of spare nodes," International Symp. On Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks (WiOpt), , Princeton, New Jersey, May 9-13, pp 375, 2011.

[3] C. Chen, Z. Wu, and Y. Jiang, "Emotion in Context: Deep Semantic Feature Fusion for Video Emotion Recognition."

[4] D. Johnson, D. Maltz and Y. Hu. "The dynamic source routing protocol for mobile ad-hoc networks", IETF MANET Working Group, Internet Draft, 2003.

[5] D. R. Faria, P. Trindade, J. Lobo, and J. Dias, "Knowledge-based reasoning from human grasp demonstrations for robot grasp synthesis," *Rob. Auton. Syst.*, vol. 62, no. 6, pp. 794–817, 2014.

[6] D.E. Culler, D. Estrin, and M.B. Srivastava. "Overview of sensor networks", IEEE Computer, 37(8):41 49, 2004.

[7] J. F. Ferreira, P. Lanillos, and J. Dias, "Fast Exact Bayesian Inference for High-Dimensional Models," 2015.

[8] K. Akkaya, M. Younis, "A survey on routing protocols for wireless Sensor networks" Elseiver Ad-Hoc Networks", vol. 3, pp.325–349, 2005.

[9] M. Faix, E. Mazer, R. Laurent, M. Othman Abdallah, R. Le Hy, and J. Lobo, "Cognitive computation: A Bayesian machine case study," *Proc. 2015 IEEE 14th Int. Conf. Cogn. Informatics Cogn. Comput. ICCI*CC 2015*, pp. 67–75, 2015.

[10] Miliefsky, G.S., 2010. Securing Voice Over Internet Protocol (VoIP). *Hakin9 Practical Protection*, 90(9), p.51. Available at: http://hakin9.org/.

[11] Mobile Ad hoc Networks", PhD Diss., Jadavpur University, Acharya Institute of Technology India.

[12] Mu Tong, Minghao Tang, "LEACH-B: An Improved LEACH Protocol for Wireless Sensor Network," Wireless Communications Networking and Mobile Computing (WiCOM), 2010 6th Int. Conf., Chengdu, China, Sept. 23-25, 2010, pp. 1-4.

[13] N. Baldo, N. Bartzoudis, J. Mangues-bafalluy, M. Payaró, M. Miozzo, and P. Dini, "An integrated testbed for full-stack 5G experimentation."

[14] Q. Dai, J. Li, J. Wang, and Y. Jiang, "Binary Optimized Hashing," 2016.

[15] S. Brienza, A. Galli, G. Anastasi, and P. Bruschi, "A Low-Cost Sensing System for Cooperative Air Quality Monitoring in Urban Areas," *Sensors*, vol. 15, no. 6, pp. 12242–12259, 2015.

[16] S. Gowrishankar, T.G. Basavaraju, M. Singh, Subir Kumar Sarkar, "Scenario based Performance Analysis of AODV and OLSR in

[17] S. Islam, M. Faraz, R. K. Ashour, G. Cai, J. Dias, and L. Seneviratne, "Adaptive sliding mode control design for quadrotor unmanned aerial vehicle," *2015 Int. Conf. Unmanned Aircr. Syst.*, pp. 34–39, 2015.

[18] Samina Ehsan, and Bechir Hamdaoui, "A Survey on Energy-Efficient Routing Techniques with QoS Assurances for Wireless Multimedia Sensor Networks", IEEE Communications Surveys & Tutorials, Vol.14, NO. 2, 2012.

[19] T. Asai, "5G Radio Access Network and its Requirements on Mobile Optical Network," pp. 7–11, 2015.

[20] Y. G. Jiang, Q. Dai, T. Mei, Y. Rui, and S. F. Chang, "Super Fast Event Recognition in Internet Videos," *IEEE Trans. Multimed.*, vol. 17, no. 8, pp. 1174–1186, 2015.

[21] Y. G. Jiang, Q. Dai, W. Liu, X. Xue, and C. W. Ngo, "Human Action Recognition in Unconstrained Videos by Explicit Motion Modeling," *IEEE Trans. Image Process.*, vol. 24, no. 11, pp. 3781–3795, 2015.

[22] Y. Jiang, Z. Wu, J. Wang, X. Xue, and S.-F. Chang, "Exploiting Feature and Class Relationships in Video Categorization with Regularized Deep Neural Networks," *arXiv Pre-print*, pp. 167–176, 2015.

[23] Y.-G. Jiang, J. Wang, Q. Wang, W. Liu, and C.-W. Ngo, "Hierarchical Visualization of Video Search Results for Topic-Based Browsing," *IEEE Trans. Multimed.*, vol. 18, no. 11, pp. 2161–2170, 2016.

[24] Y.-G. Jiang, S. Bhattacharya, S.-F. Chang, and M. Shah, "High-level event recognition in unconstrained videos," *Ijmir*, vol. 2, no. 2, pp. 73–101, 2012.

[25] Yang, Y., 2011. Tutorial on Classification Outline. *Masterchemoinfo.U-Strasbg.Fr*, pp.1–27. Available at: http://masterchemoinfo.u-strasbg.fr/Documents/TutoChemo/classification.pdf.

[26] Yang, Ying. "Time Synchronization in Wireless Sensor Networks: A Survey, MS Diss. mid Sweden University, 2012.

[27] Z. Alexei and Z. Arkady, "Three-dimensional Reconstruction from Projections based on Incidence Matrices of Patterns," *AASRI Procedia*, vol. 9, no. Csp, pp. 72–77, 2014.

[28] Z. Jin, J. Cao, Y.-G. Jiang, and Y. Zhang, "News Credibility Evaluation on Microblog with a Hierarchical Propagation Model," *2014 IEEE Int. Conf. Data Min.*, pp. 230–239, 2014.