International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 10, Issue 8, August 2021)

An Efficient Congestion and Collision Resolution MIMO-CSMA/C_n Multipath Routing Technique in MANET

Wg. Cdr. (Retd.) Arif Ullah Khan[1], Dr. Shiv Shakti Shrivastava[2]

[1]*Ph. D. Scholar,* [2]*Professor, Department Computer Science, Rabindranath Tagore University, Bhopal (M.P.), India*

arifukhan2@gmail.com[1], shivshakti18@gmail.com[2]

Abstract- **The sensor nodes are small or tiny but its functioning is really effective in terms of static as well as dynamic communication. In dynamic communication, the challenge is to maintain a reliable or strong connection is established between the nodes in heavy traffic condition. The AOMDV routing protocol is the multipath on-demand protocol used at the intermediate nodes for routing. Duplicate copies of a request are not immediately discarded. Each packet is scrutinized to see, if it provides a node-disjoint path to the source. For node-disjoint paths, all requests need to arrive via different neighbors of the source but multiple channel allocation is enhancing the capacity of handling available bandwidth. In this research the CSMA/Cn is proposed to handle the problem of channel allocation to multiple senders is possible. The proposed CSMA/Cn technique is able to handle control the congestion and keep the load below the capacity. It is a mechanism that can either avoid congestion, before it happens, or notified congestion after it has happened. The performance of the proposed CSMA/Cn is compared with AOMDV-Cn. The objective of CSMA/Cn is to maintain the number of packets within the network below the level at which performance falls off dramatically and also provide the same route to other node but the channel is different to utilize bandwidth. Due to the impulsive fluctuations and burstiness of traffic flows within loaded network congestion can occur frequently but through the proposed approach, it is possible to minimize it. So propose CSMA/Cn efficient congestion control technique is really candid performance against congestion as well as collision. Previous experience in the design of congestion control algorithms has shown that at each link, the number of flows utilizing the link is necessary in order to maintain stability in the presence of delays and for improving performance.**

Keywords: **CSMA/Cn, AOMDV-Cn. WSN, Routing, Channel, Congestion**

I. INTRODUCTION

A Mobile Ad hoc Network (MANET) is made up of two nodes that act as routers, forwarding packets without the need for any infrastructure or centralized administration. This is a self-organizing, self-maintaining, and random network.

Because of the tremendous flexibility provided by MANETs, we confront numerous difficulties in spectrum sharing, media access, energy consumption, packet routing, and other areas. One of the most difficult problems with any of these subjects is how to effectively route packets due to the unreliability of the wireless medium and the complicated topology.

In this chapter, we'll look at some of the other aspects of MANETs. We'll begin with a general review of wireless networks, reference models, and wireless technologies utilized in the physical and data connection layers. We'll next discuss MANETs in general, including their challenges, issues, and solutions. We focus on the MANET routing protocol, which is also the study's main subject of discussion. The two main kinds of MANET routing protocols, as well as its extensions: multipath, QoS, protection, and so on, are addressed. At the conclusion of this section, we provide several MANET testbeds, which are an essential element of MANET testing since they put MANETs into the actual world [10-13].

II. RELATED WORK

The recent work is finished in field of CSMA and multipath routing is mentioned in this section. These works are terribly effective having done some new reduces stinginess and downside of congestion in DTN.

Souvik Sen, et. al. [1] “Carrier Sense Multiple Access with Collision Notification" is a proposal. In their work, they use a novel scheme called CSMA/CN to approximate CSMA/CD in wireless networks (collision notification). The receiver in CSMA/CN detects a collision using Physical layer information and immediately notifies the transmitter. A specific signature is sent on the same channel as the data in the collision notification. To determine this warning, the transmitter uses a listener antenna and performs signature correlation. The transmitter instantly aborts the transmission once it has been detected. They demonstrate that even in the presence of heavy self-interference from the transmit antenna, the notification signature can be reliably detected at the listener antenna.

The feasibility and efficacy of CSMA/CN was demonstrated by a prototype test-bed of ten USRP/GNU radios.

To increase the efficiency of the MAC system, Yishan Su et al. [2] suggest a scheme in which they attempt to combine channel state estimation in the physical layer, the actual measurement matrix, and requests/grants in the data link layer. A new cross-layer CS-MAC (CL CS-MAC) scheme is proposed here, which combines the physical layer's channel state with MAC layer requests to deal with the collision of multiple transmitted packets using compressed sensing. The scheme is more effective since compressive complex requests are used to locate the active sensor node. There are no bit or frame synchronizations needed because the reconstruction process is carried out in the complex field of the physical layer.

"A Transmission Power/Rate Control Scheme in CSMA/CA-Based Wireless Ad Hoc Networks," as proposed by Han-Chiuan Luo et al [3]. The aim of this work is to increase the network throughputs of carrier-sense-multiple access with collision avoidance (CSMA/CA)-based wireless unexpected networks with multiple transmission rates by developing a new transmission power and rate management theme. The scheme's concept is to make efficient use of the space-time resource. Space-time resource consumption per bit transmission is implemented for this reason. Under the two-ray ground reflection model and the Ricean model, simulation results show that the proposed scheme is successful in network throughputs.

"Improving the Performance of Wireless Ad Hoc Networks by MAC Layer Design," Mariam Kaynia et al. [4] propose. They investigate and evaluate the output of the ALOHA (Additive Links On-line Hawaii Area) and the CSMA in this title. In spatially dispersed wireless networks, MAC protocols are investigated. The aim of the researchers is to correct data packet reception, so the study is done in terms of outage probability. Packets from individual transmitters arrive randomly in space and time according to a 3-D Poisson point mechanism in the network model, and are then sent to their intended destinations using a completely distributed MAC protocol. They find that packet transmission is effective if the received SINR (signal-to-interference-plus-noise ratio) is greater than a predetermined threshold for the length of the packet. As a function of the transmitter density, the number of bakeoffs, and retransmissions, precise limits on the outage probabilities is extracted.

Decentralized Detection in Ad hoc Sensor Networks with Low Data Rate Inter Sensor Communication is the subject of Lu Zheng et al. work. [5]. They suggest a consensus-based detection scheme in which sensors exchange local decisions, update their own decisions based on the exchanges, and eventually come to an agreement about the state of nature. They look at the decision consensus scheme's error likelihood and convergence. They show that, in terms of error exponents, the detection output in ad-hoc networks is asymptotically equivalent to that of a parallel sensor network with all local decisions processed by a central node (fusion centre) using their scheme. The consensus time's probability distribution is also investigated.

"Design and Analysis of Adaptive Receiver Transmission Protocols for Receiver Blocking Problem in Wireless Ad Hoc Networks," by Kai-Ten Feng et al.[6]. Multiple receiver transmission (MRT) and quick NAV truncation (FNT) mechanisms are suggested in this title to mitigate receiver blocking without the use of additional control channels. With dynamic adjustment of the selected receivers, the adaptive receiver transmission (ART) scheme is proposed to further improve throughput efficiency. The analytical model is also used to validate the proposed ART protocol's efficacy. The proposed three protocols are evaluated and compared to current MAC schemes using simulations. It can be shown that the proposed ART protocol outperforms other schemes in terms of resolving the receiver blocking problem and improving throughput in wireless multi-hop ad hoc networks.

"CSMA Based Cross-Layer Framework with Integrated Routing and Scheduling In Ad Hoc Networks" is proposed by Rajalakshmi. R.S, et. al. [7]. A system is being developed to find applications in military fields and other emergency situations. MANETS are used in these types of applications. The proposed architecture employs a cross-layer framework in which protocols from various layers exchange network information while maintaining layer separation. The system has mesh-driven routing built in. Instead of using the TDMA technique, the CSMA/CD algorithm is used for scheduling. This algorithm is more effective at detecting collisions and reducing collisions. Using the CSMA/CD method, the bandwidth is measured and efficiently shared among the channels. In addition, the CSMA protocol has a low control overhead and a high bandwidth performance [8-9].

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 10, Issue 8, August 2021)

III. Proposed Research

Wireless sensor communication is a collection of tiny sensor node which capable to gather specific data and forward to base station. As their limitation sensor network struggle from many challenges such as congestion, limited energy, limited processing power etc. in this paper focus to resolve the problem of congestion and improve the performance of data communication. In the sensor network some of node perform special task such as routing interconnection between node that's why special node is heavy utilized by the rest of senor node and increase the congestion. Multipath routing is one of the best solutions to overcome the problem of congestion, in this proposed approach network layer and data link layer based technique resolve the congestion problem and improve the efficiency of network. In the network layer ad hoc on demand multipath distance vector routing (AOMDV) is used to provide multiple path for data transmission which helps to maximum channel utilization and load balancing. Similarly data link layer we use MAC technique as carrier sense multiple access with collision notification (CSMA/Cn) which helps to reduce the collision of the network. In the proposed approach combine both layer technique and name as M-CSMA/C_n which completely overcome the problem of network congestion and collision. For the multipath establishment we also use the multiple input and multiple output antenna (MIMO) which capable to transmit and receive the data simultaneously. The Proposed work handle the congestion problem by the below three layer such name also called network oriented layers which protect from congestion as well as collision. All the three layer working methodology describe in brief.

A. M-CSMA/Cn Network Layer Working:

Proposed multipath CSMA/C_n mechanism network layer responsible to provide multipath communication, which is useful for congestion minimization and load balancing in the network. In this layer the main functionality to provide routes to source node is to deliver data to the destination node. Initially source node call on-demand based routing (AOMDV) which initiate route request packet and broadcast routing packet in to the network. The broadcasted route packet comes into the intermediate node which put queue capacity, bandwidth data into routing packet and forward to next hop by broadcast mechanism. Finally route packet reach into the destination node which cerate distinct routing table for distinct route.

Destination assigns the priority in sequential order which queue and channel capacity higher than the threshold and average capacity is high, at the end destination select best three higher prioritized path for communication. Proposed enhanced AOMDV routing provides more reliable and low congestion path.

B. M-CSMA/Cn Data Link & Physical Layer Working:

Data link layer basically deal with congestion and collision resolution, data link layer responsible to send data one hop to next hop. In our proposed approach MAC protocol use as carrier sense multiple access with collision notification (CSMA/C_n) which provide wireless connectivity to next node. CSMA/C_n uses RTS/CTS mechanism where sender initiate request to send message and next hop send clear to send message to all connected node with node id, the CTS message confirm to all source node which node take the channel for communication out of all source by the node id and all other source node wait for next time. The RTS/CTS mechanism avoids the collision, CSMA/C_n also responsible for collision notification if collision occur during the data communication. In proposed technique for the data transmission use the multi-input/multi-output (MIMO) antenna which helps to any receiver to receives data by multiple transmitter in simultaneous way without the collision. MIMO antenna is useful while the data receiving by multiple source node in same time.

Finally proposed M-CSMA/C_n module are develop and inbuilt under the network simulator-2, the proposed M-CSMA/C_n simulation experimental result retrieve.

IV. Proposed Algorithm

M-CSMA/C_n protocol is useful to resolve the problem of congestion and collision in WSN network, in this section describe the formal way of algorithm which is simulated under network simulator-2. With the help of proposed algorithm WSN is more reliable and practical approachable system as compare to existing methodology.

Algorithm: An Efficient Congestion and Collision Resolution MIMO-CSMA/C_n Multipath Routing Technique in WSN

Input: Channel Capacity (CC), Available Queue Size (AQS), Threshold (Th)

Output: Data Send (DS), Data Receive (DR), Data Drop (DD), Packet Delivery Ratio (PDR), Throughput, Average Delay (AD)

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 10, Issue 8, August 2021)

Procedure:

1. Deploy Sensor Network, sensor node, source and destination node
2. Initialize CC: 5Mb, QS: 100 and Th:20%
3. Source use Routing Protocol AOMDV and Search Route, ∀hop in route
4. **While** Destination found by multiple route

Destination create distinct routing table

Evaluate CC, AQS of each route by Compare with Th value and set priority

Arrange all route based on Higher Priority

5. **Return** Select Efficient Three Route
6. Call Data Sending Module
7. Use MIMO with CSMA/C_n for data sending to Destination node
8. **If** Destination Receives data by multiple Source node in Same time

Use MIMO antenna to receive in efficient way

End If

End Procedure

V. Simulation Parameters

The simulation of Proposed-CSMA/Cn and previous CSMA/ Cn scheme are based on following parameters. The five scenarios of nodes are taken to measures the performance. The multipath protocols are better then uni-path because of availability of instant alternative path in network. . The simulation results are based on the simulation parameters. In this research the routing protocol used for simulation is AOMDV, Radio Range of nodes are 250meters and modes are move in network through random way point model. The performance of protocol is measure in different node density scenario in dynamic network.

Table 1
Simulation Parameters

Parameters	Value
Network Type	WSN
Nodes/Devices	10, 25, 50, 100
Physical Medium	Wireless
Simulation Time	100 seconds
MAC Layer	CSMA/Cn,M-CSMA/Cn
Routing Protocol	AOMDV
Traffic Type	CBR, FTP
Number of Connection	10,20
Propagation radio model	Two ray ground
Rate	10 Packet/s

A. Data Send Analysis

The number sender nodes exist in dynamic network and these nodes are continuously sending data packets to receiver. The receiver are receive the amount of data s the sender is send in network. In this graph the data sending analysis is measures in 10, 25, 50, 75 and 100 different node density scenario is measures. The previous AODV-Cn protocol and proposed-CSMA/Cn protocol sending packets performance is measures and observe that the more number of data sending means receiver are properly response and congestion is reduces by that data loss possibility in network is reduces. The sending in Proposed-CSMA/Cn is about maximum and having difference more than 7800 packets. The exact figures are mentioned in table of figure 1.

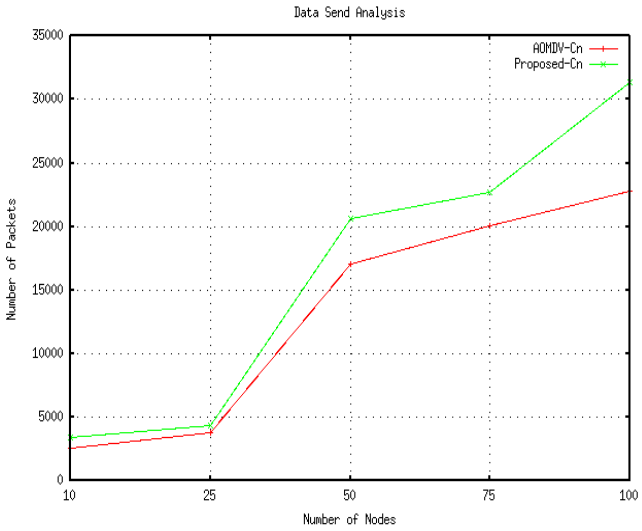

Fig.1 Data Send Analysis

Table 2:
Total Data Send

Nodes	AOMDV-Cn	Proposed-Cn
10	2614	3439
25	3789	4369
50	17085	20609
75	20100	22701
100	22765	31344

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 10, Issue 8, August 2021)

B. Data Receives Analysis

In WSN nodes having continuously change topology and sends data packer sends in network. Actually the performance of network is measured at receiving end in network. The proper data receiving is improves the performance because every performance is based on the less data drop in any network at routing layer. In this graph the previous AOMDV-Cn performance is compare with proposed-CSMA/Cn routing in WSN. The link between the nodes is not expiring due to the unnecessary energy consumption in network. The difference in packet receiving is really very high that shows the better performance.

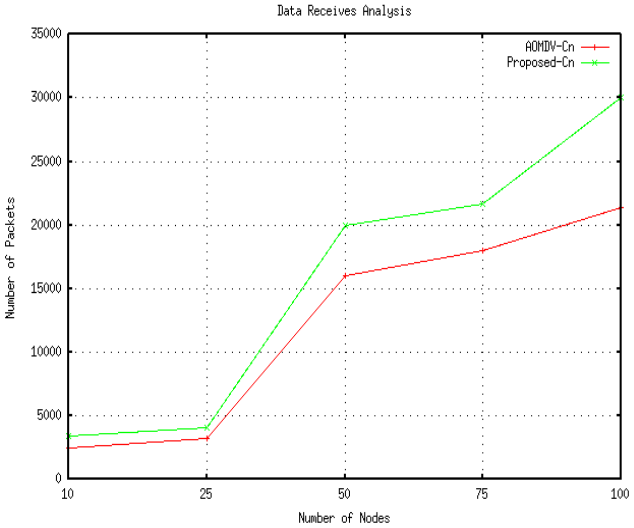

Fig.2 Data Receiving Analysis

Table 3:
Total Data Receives

Nodes	AOMDV-Cn	Proposed-Cn
10	2481	3419
25	3268	4052
50	16048	19960
75	17993	21679
100	21387	30080

C. Packet Delivery Ratio Analysis

The sensor nodes proper packets sending and receiving in network is shows the better routing performance.

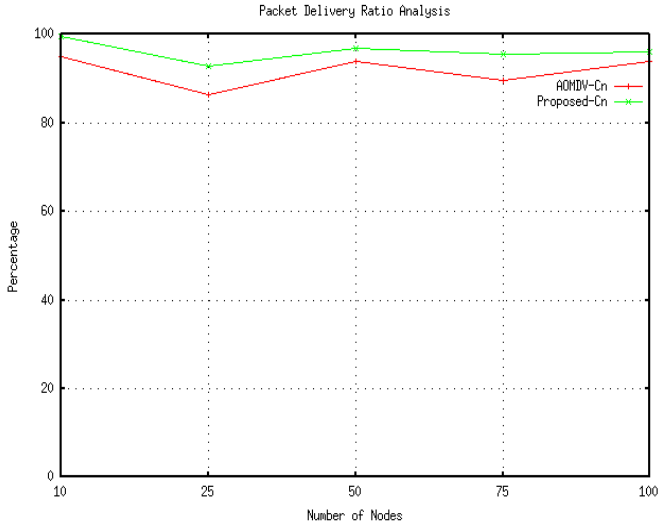

Fig. 3 PDR Analysis

The PDR performance is entirely based on the ratio of number of data packets received and send in dynamic network. The performance is little bit vary in different node density scenarios but the performance of proposed-CSMA/Cn is reaches to 98% and minimum up to 96% i.e. always more as compare to previous AOMDV-Cn scheme. The performance is not cross the limit of 98% in 100 nodes density and it is observable that if node density is high then the performance in network is also produces better PDR performance.

Table 4:
Packet Delivery Ratio

Nodes	AOMDV-Cn	Proposed-Cn
10	94.91	99.42
5	86.25	92.74
50	93.93	96.85
75	89.52	95.5
100	93.95	95.97

D. Normal Routing Load Analysis

The nodes are freely moves in network with random speed and their distance from each node is change continuously and also the distance among the nodes are vary time to time. That means the dynamic link connectivity between the nodes is the big problem.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435(Online) Volume 10, Issue 8, August 2021)

The destination is not directly available for sending data packets. The enhanced routing packets flooding in the network is also enhancing the possibility of link breakage because of that routing performance is affected. The routing overhead in all node density scenarios is minimum in proposed-CSMA/Cn routing as compare to previous AOMDV-Cn scheme. The overhead is less compare packets receiving is high that means the proposed approach is effective for communication.

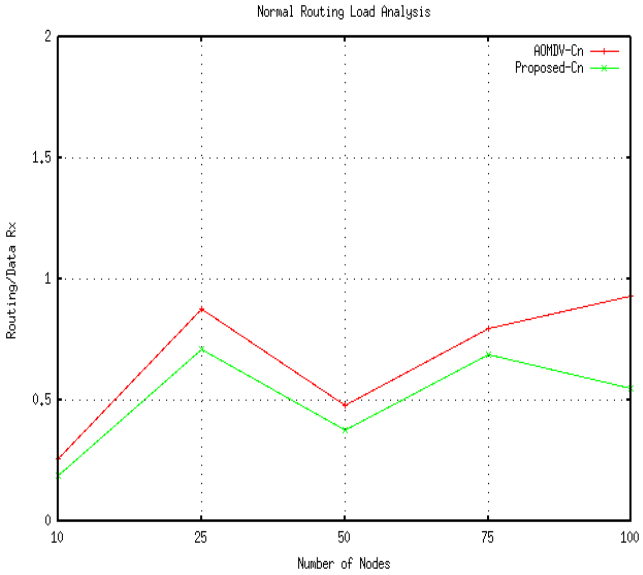

Fig.4 Normal Routing Load Analysis

Table 5:
Normal Routing Load

Nodes	AOMDV-Cn	Proposed-Cn
10	0.26	0.19
25	0.88	0.71
50	0.48	0.38
75	0.8	0.69
100	0.93	0.55

VI. Conclusion And Future Work

The objective of CSMA/Cn with AOMDV is to minimize the possibility of congestion and collision in the network and also because of that number of packets is receiving more and reduces dropping dramatically. The proposed CSMA/Cn approach is also providing the same route but the channel is different to utilize bandwidth.

In this research, we proposed the congestion control multipath and multi-channel technique for sending data between the sender and receiver. The load is balanced in each existing route and proposes a CSMA/Cn mechanism is capable for it. CSMA/Cn is a MAC layer protocol that provider's collision-free communitarian and also gives information of busy as well as free channel information, that information useful for balancing the load of each existing path between senders to receiver mobile device. According to various definitions if routing overhead is minimum that means data receiving performance is better. Whereas if the number of routing packets is very high, it can be concluded that the network performance is poor because maximum bandwidth and time is being used by the routing packets. In proposed CSMA/Cn approach very first we set initial parameter and routing protocol as AOMDV routing we select more than one path from sender to receiver, we also set node initial energy and media access control as carrier sense multiple access with collision avoidance that gives better performance under multipath routing scheme. Here senders broadcast routing packet and check channel as ideal, if the channel is idle than intermediate node receives and that packet re-broadcast and that packet send's through multiple paths and also multiple channels into receiver node. The basic motive to increase the network performance of the network through the quality of service parameter and our outcomes in the form of network parameters like packet delivery ratio, throughput, end-to-end delay, routing overhead, data rate, etc. all those parameter base we conclude our work. As a result of PDR (packet delivery ratio), throughput is improved, and end-to-end delay, routing load, data drop decrease.

The collision and congestion are not possible to totally remove from the network but possibly to minimize some factors that maximize performance. In the future, we work on Foreign Agent (FA) and Base Agent (BA) mechanism to control congestion is a private network. The information is encrypted by using MD5 or HMAC security algorithms.

REFERENCES

[1] Souvik Sen, Member, IEEE, Romit Roy Choudhury, Member, IEEE, and Srihari Nelakuditi, Member, IEEE, CSMA/CN: Carrier Sense Multiple Access with Collision Notification, National Science Foundation (NSF) grants CNS-0448272, CNS-0747206, CNS-1017276, and CNS-1018369, 2017.

[2] Yishan Su Xiaomei Fu Guangyao Han , Naishen Xu and Zhigang Jin, " Implementation of a Cross-Layer Sensing Medium-Access Control Scheme", Article, Alessandro Bogliolo, 10 April 2017.

[3] Han-Chiuan Luo, Eric Hsiao-Kuang Wu, Member, IEEE, and Gen-Huey Chen, A Transmission Power/Rate Control Scheme in CSMA/CA-Based Wireless Ad Hoc Networks, IEEE transactions on vehicular technology, vol. 62, no. 1, January 2013.

[4] Mariam Kaynia, Student Member, IEEE, Nihar Jindal, Member, IEEE, and Geir E. Øien, Senior Member, IEEE, Improving the Performance of Wireless Ad Hoc Networks Through MAC Layer Design, IEEE transactions on wireless communications, vol. 10, no. 1, January 2011

[5] Lu Zheng, Yingwei Yao, Member, IEEE, Mo Deng, and Stephen S. T. Yau, Decentralized Detection in Ad hoc Sensor Networks with Low Data Rate Inter Sensor Communication, IEEE transactions on information theory, vol. 58, no. 5, may 2012.

[6] Kai-Ten Feng, Member, IEEE, Jia-Shi Lin, Student Member, IEEE, and Wei-Neng Lei, Design and Analysis of Adaptive Receiver Transmission Protocols for Receiver Blocking Problem in Wireless Ad Hoc Networks, IEEE transactions on mobile computing, vol. 12, no. 8, august 2013.

[7] Rajalekshmy.R.S, J.Jayalakshmi "CSMA Based Cross Layer Framework with Integrated Routing and Scheduling In Ad Hoc Networks" International Journal of Industrial Electronics and Electrical Engineering, ISSN: 2347-6982 Volume-2, Issue-4, April-2014.

[8] Verma, S. and Singh, P. (2014) Energy Efficient Routing in MANET: A Survey. International Journal of Engineering and Computer Science, 3, 3971-3977.

[9] Mamatha, G. and Sharma, D.S. (2010) Analyzing the MANET Variations, Challenges, Capacity and Protocol Issues. International Journal of Computer Science & Engineering Survey, 1, 14-21.

[10] Goyal, P., Parmar, V. and Rishi, R. (2011) Manet: Vulnerabilities, Challenges, Attacks, Application. International Journal of Computational Engineering & Management, 11, 32-37.

[11] Aftab, M.U., Nisar, A., Asif, D., Ashraf, A. and Gill, B. (2013) RBAC Architecture Design Issues in Institutions Collaborative Environment. International Journal of Computer Science Issues, 10, 216-221.

[12] Aftab, M.U., Habib, M.A., Mehmood, N., Aslam, M. and Irfan, M. (2015) Attributed Role Based Access Control Model. Conference on Information Assurance and Cyber Security (CIACS), Rawalpindi, 18 December 2015, 83-89.

[13] Chitkara, M. and Ahmad, M.W. (2014) Review on MANET: Characteristics, Challenges, Imperatives and Routing Protocols. International Journal of Computer Science and Mobile Computing, 3, 432-437.