The Directional Hierarchical AODV, DSR, DYMO Routing Protocol for Wireless Mesh Network Using Exata Simulator

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Abstract: -*Wireless mesh networks (WMNs) can be considered as a key technology for next-generation wireless networking. However, field trials and experiments prove that the performance of WMNs still below expectations. Therefore, several challenging research issues need to be determined. The routing protocol is one of the important factors to be improved to be robust, scalable, secured and efficient. WMNs are low-cost access networks built on cooperative routing over a backbone composed of stationary wireless routers. WMNs must deal with the highly unstable wireless medium. Therefore, the design of algorithms that consider link quality to choose the best routes are enabling routing metrics and protocols to evolve. In this work, we analyze the state of the art in WMN metrics and propose taxonomy for WMN routing protocols. Performance measurements for a WMN, deployed using various routing metrics, are presented and corroborate our analysis. This paper aims to design and implement a routing protocol that improves the scalability of the WMNs. The Directional Hierarchical AODV (DH-AODV) routing protocol is proposed taking advantage of the existing fields of the control packets in the AODV in order to reduce the load on the network's bandwidth and to quickly detect route breakage. The proposed protocol is designed, implemented and evaluated using Qualnet Simulator. The Ad-hoc on-Demand Distance Vector (AODV) is selected as a benchmark. The simulation results indicate that this enhanced routing protocol can 47% reduce the end-to-end delay of data packets, improve the throughput by 11.2%, and decrease the packet loss rate 20% less than the standard AODV.*

Keywords— Wireless Networks; WMN; DH-AODV; scalability; robustness; throughput; Qualnet Simulator.

1. INTRODUCTION

Wireless networks transformed our lives and ways to connect to the Internet or another network seemingly and transparently, provided one is under the "umbrella" of an access point. Wireless Mesh Networks extend this connectivity to far greater distances. Wireless Mesh Networks or WMNs for short are a rapidly growing and very promising technology. Similarly to the paradigm shift that created the Internet in 1960s; this technology is expected, due to its self-healing, self configuration, self-organization and broadband capacity, to play an important role in the direction of future wireless ad-hoc networks. Wireless Mesh Networks are desirable, as they are: easy to deploy and maintain, less expensive than other solutions with high scalability, resilience and reliable services. These characteristics are pushing the international organizations that create standards to actively look out for specifications, for instance, IEEE 802.11s (WMN), IEEE 802.11 (WLAN), IEEE 802.15 (WPAN), IEEE 802.16 (WMAN) and IEEE 802.20 (MBWA).

The wireless mesh network (WMN) is a mesh network implemented over a wireless network system. It is a point-to-point-to-point, or peer-to-peer, system. A node can send and receive messages, and also functions as a router and relay messages for its neighbors. Through the relaying process, a packet of wireless data will find its way to its destination, passing through intermediate nodes with reliable communication links. Like other peer-to-peer router-based networks, a mesh network offers multiple redundant communications paths throughout the network. If one link fails for any reason, the network automatically routes messages through alternate paths. Such networks are characterized by dynamic self organization, self-configuration and self-healing.

These are enable flexible integration, quick deployment, easy maintenance, low cost, high scalability and reliable services. Furthermore, it enhanced the network Capacity, connectivity and throughput in multi-hop ad-hoc networks, wireless personal area networks (PAN), wireless local area networks (LAN), wireless metropolitan area networks (MAN) and wireless wide area networks (WAN). Since WMNs can be viewed as a special case of wireless multi-hop ad-hoc networks, the routing protocols developed for ad-hoc networks can be applied to WMNs. However, WMNs have a number of features that distinguish them from pure ad-hoc networks. First, the positions of different nodes of a WMN are relatively fixed and any change of position is limited within certain range. Second, unlike pure ad-hoc networks, where the traffic flows between arbitrary pairs of nodes, in WMN, all traffic is either to or from a designated gateway, which connects the wireless mesh network to the Internet. Third, the nodes will typically have access to a power source, and so power consumption is not a critical issue.

Finally, such systems can be created within a single domain of authority, and so many security issues present in ad-hoc networks are no longer relevant. Due to its popularity and flexibility to be modified, AODV protocol was chosen to be enhanced in order to improve its performance in WMNs. Furthermore, it can be considered as a moderate protocol in many metrics compared with other protocols as stated in. AODV is a method of routing messages between mobile nodes. It allows these nodes to pass messages through their neighbors to nodes which they cannot directly communicate with. That can be done by discovering the routes along which messages can be passed. AODV makes sure these routes do not contain loops and tries to find the shortest route possible. AODV is also able to handle changes in routes and can create new routes if there is an error.

Wireless mesh network and mobile ad-hoc networks are examples of wireless ad-hoc networks. Routing is one specific process in these networks through which data is send from source to destination using some routing algorithms/protocols. In which network environment which routing protocol is well suited depends upon condition to condition like topology type, number of nodes, routing overhead, types of data to be send etc. Analysis of ad-hoc routing protocols in different network scenarios have been done in various research articles.

WMN is an inherited technology from many existing schemes, thus offers combined merit from generation from these network architectures in supporting next generation wireless communication. These days, people use cell phone in a server-client mode supported by a Base Station (BS) like WLAN Access Point (AP), the coverage of a single BS is limited and if MH gives out of the service region, the wireless link becomes too weak to maintain. Therefore, a multilink network is built with many BSs to cover a wider region whose combined coverage makes ubiquitous access to MHs, thereby supporting MH's mobility. Leaving from cellular system.

2. PROPOSED WORK

Proposed the directional AODV (D-AODV) as an enhancement of AODV. Its main concept is to use the hop counts to broadcast the packets toward and from the gateway only and discard the rest when the communication is between a node in the mesh network and the global Internet. However, the hop count metric used by AODV and D-AODV is helping to find the shortest path between the source node and the destination. But this shortest path may not be the best since it is not considering the quality of the shortest path, the data rate nor the medium stability. Therefore, we proposed a new enhancement of AODV namely the hierarchical directional AODV (DH-AODV).

1. Route Request

The HELLO messages sent by the gateway at the network initial phase are enabling each node to know how far it is from the gateway using the hop count. While the AODV functions normally with traffic between two nodes inside the network, The RREQ packets can be directed to reach the gateway without bother all the nodes in the network.

2. Route Reply

RREQ reaches the gateway and it unicasts a RREP. The node receiving a RREP sets up a forward route to the gateway and desirable routes can be discovered. The proposed DH-AODV is reducing the number of the active nodes during the route discovery phase considering the latest sequence numbers received by the nodes beside the hop counts. By doing that, the shortest and freshest path will be chosen which reduces the delay before sending a packet and shortens the total end-to-end delay as a result.

3. AODV:

AODV expanded as Ad-hoc on demand distance vector routing protocol. It is an enhancement to the DSDV routing protocol. It performs Route Discovery and Route Maintenance process and incorporates hop-by-hop routing concept from

DSDV.

4. DSR:

DSR expanded as Dynamic Source Routing. It is a reactive routing protocol which has two main operations: route discovery and route maintenance. It uses the route caching concept. Route discovery is used by a source node to establish a route to destination node. Source node broadcasts RREQ message and intermediate node receives RREQ message, it appends its address and forwards it again till it reaches the destination.

5.DYMO:

DYMO stands for Dynamic MANET On Demand Routing Protocol. It is a successor of AODV routing protocol. DYMO is a purely reactive routing protocol in which routes are discovered on demand i,e as when needed. DYMO supports the feature of Path accumulation. DYMO does not support unnecessary HELLO messages and operation is purely based on sequence numbers allotted to all the packets.

6. EXATA SIMULATOR

The EXata communications simulation platform (EXata) is a network emulator that lets you evaluate on-the-move communication networks faster and with more realism than any other tool. It uses a software virtual network (SVN) to digitally represent the entire network, the various protocol layers, antennas, and devices. The system can interoperate, at one or more protocol layers, with real radios and devices to provide hardware-in-the-loop capabilities. EXata can also be connected to systems with real applications, which run on the SVN just as they would run on real networks.

3. EXPERIMENTATION

To evaluate the performance of the proposed DH-AODV protocol in a hybrid wireless mesh networks and compare it with AODV protocol, a simulation using QualNet Simulator is done .A grid topology was considered, with 1500 m×3000m area with 31 nodes distributed 300 m apart. Only one of them is set as a gateway placed at the edge of the network. Each node uses the PHY802.11b model and the 802.11 MAC protocol. Also, a constant bit rate (CBR) traffic source with512-byte data packets was considered, and that all traffic of source randomly selected is destined toward Internet through a gateway. We assumed that the link bandwidth is 2Mbps and the CBR traffic sending rate is 4 packets/sec. Simulations were run for 3600 seconds.

Parameters Table:

Parameter	Values
Terrain	1500m*3000m
Number of nodes	31
Physical Layer	802.11b radio
MAC Layer	802.11
Routing Protocol	AODV
Routing Mechanism	Full TTL(AODV) Expending Ring (DHAODV)
Application Traffic	CBR
Packets load	4 Packets per second
Simulation Time	3600seconds

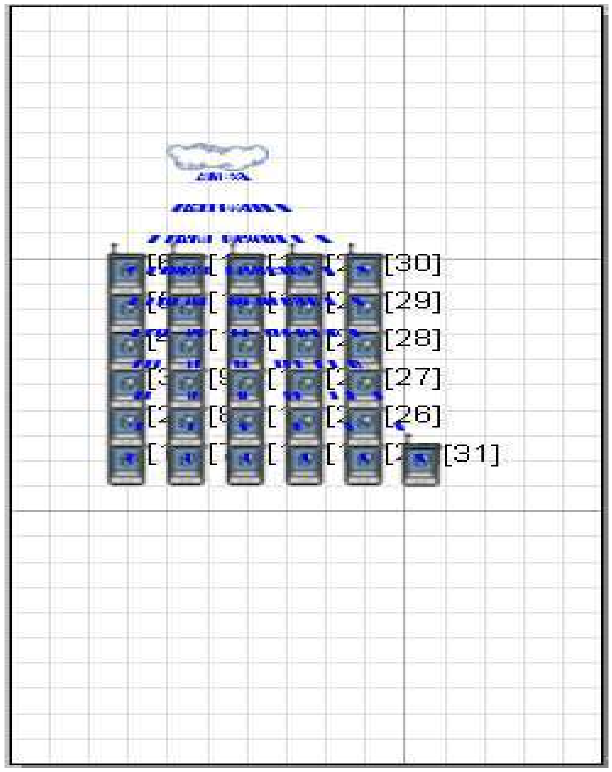
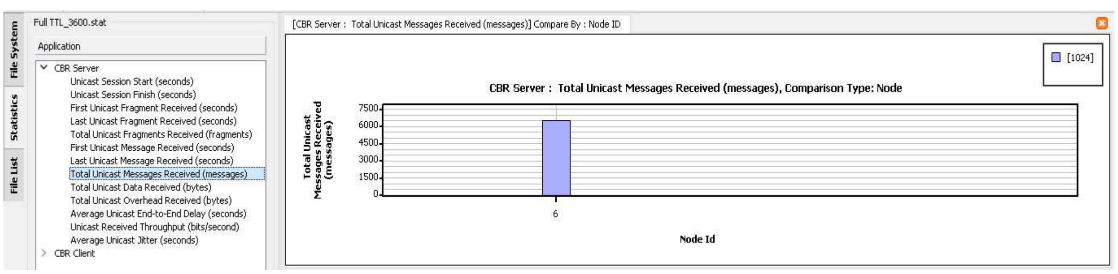
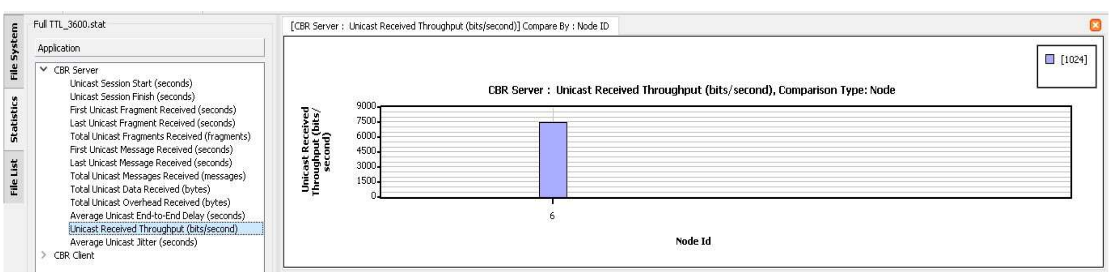


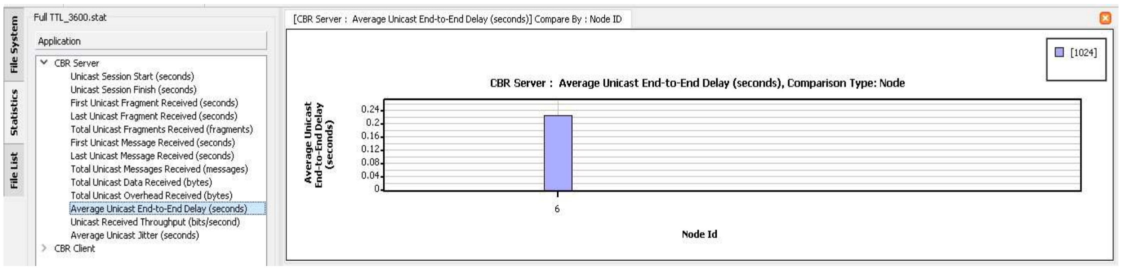
Figure Select all the nodes and connect to wireless subnet.

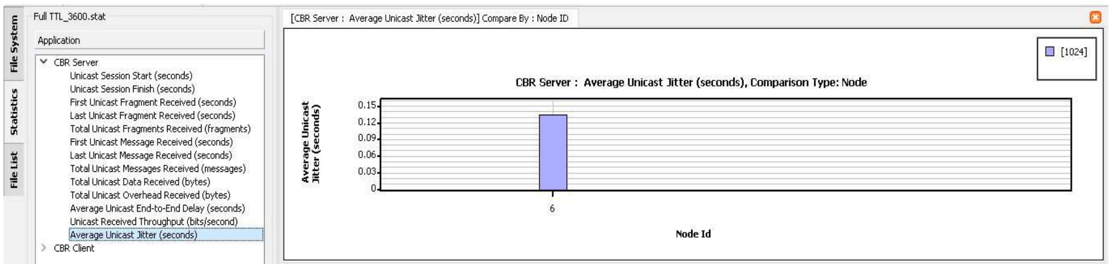
Statistics Graphs:

AODV Statistics

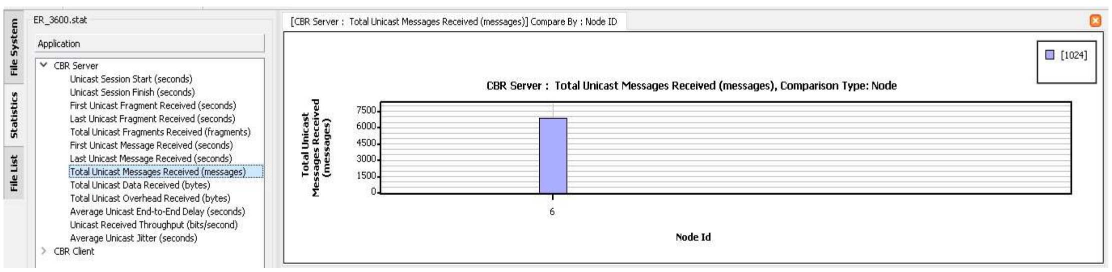


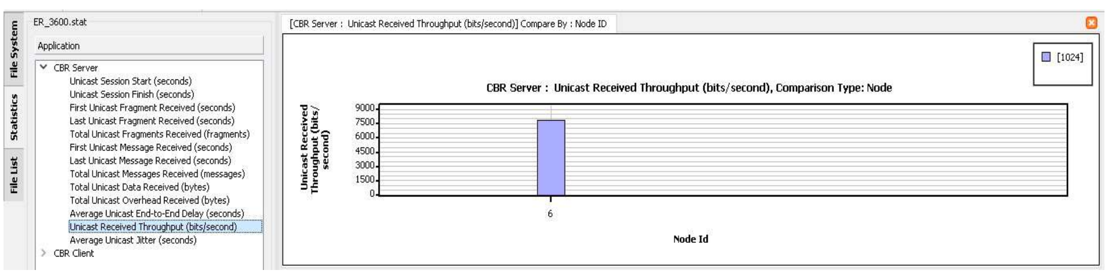


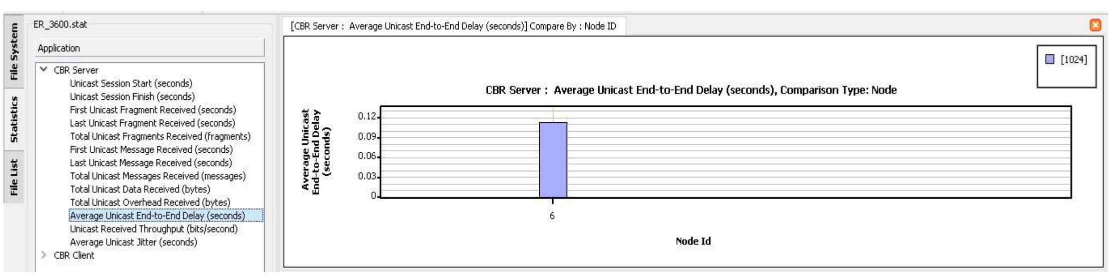


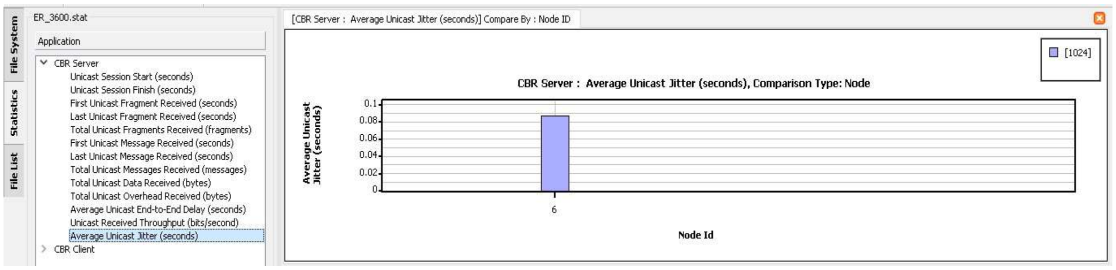


DHAODV Statistics:









Output Tables and Generated Graphs:

Packets Received

	3600
AODV	6612
DHAODV	6980

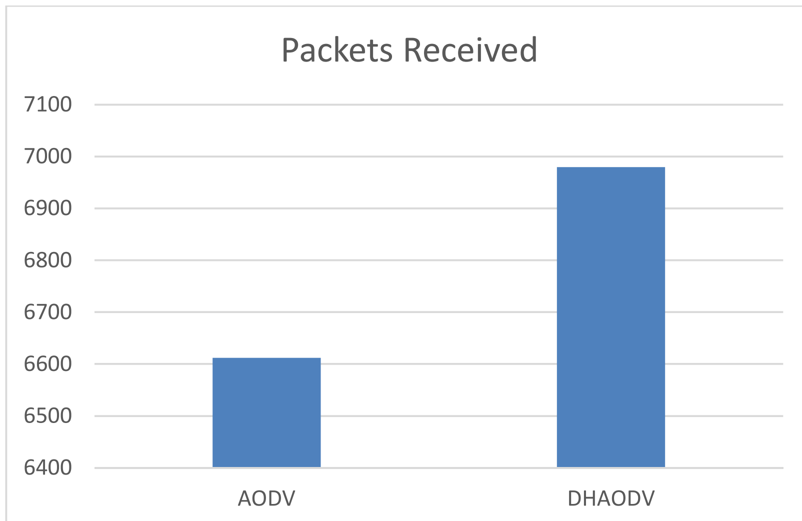


Figure 1.Total Packets Received

Throughput

	3600
AODV	7566
DHAODV	7978

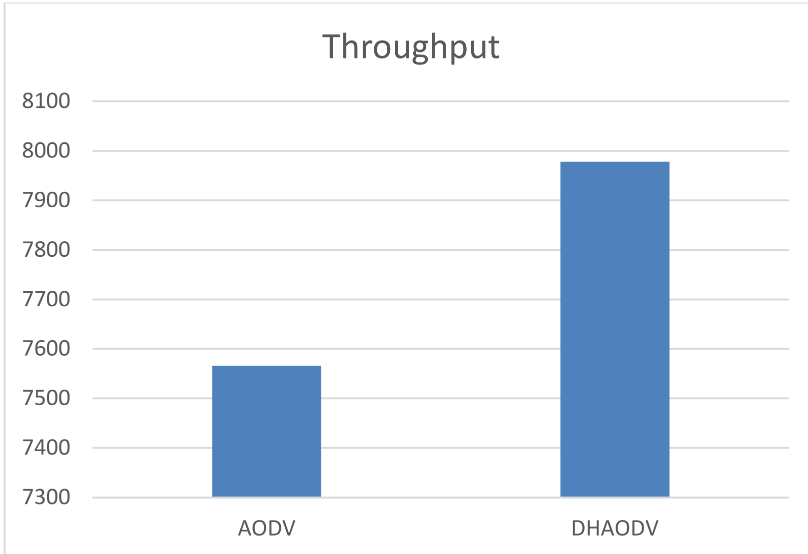


Figure 2.Throughput Output

Delay

	3600
AODV	0.228
DHAODV	0.114

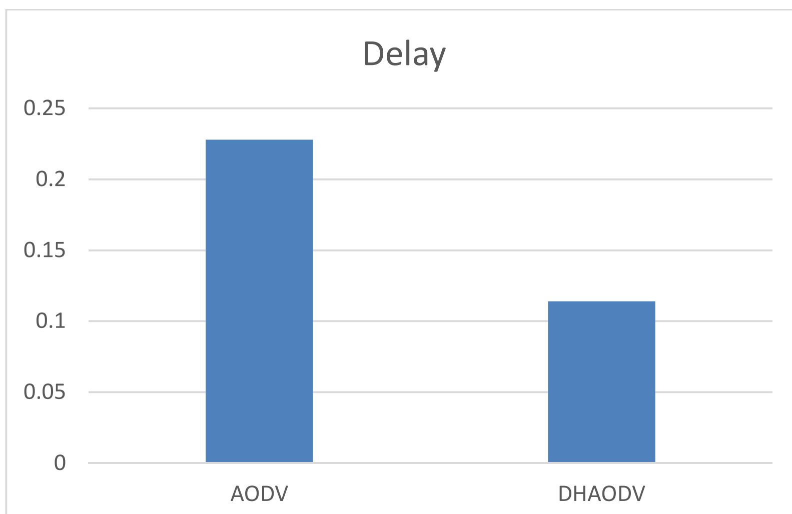


Figure 3.Delay Output

Jitter

	3600
AODV	0.136
DHAODV	0.088

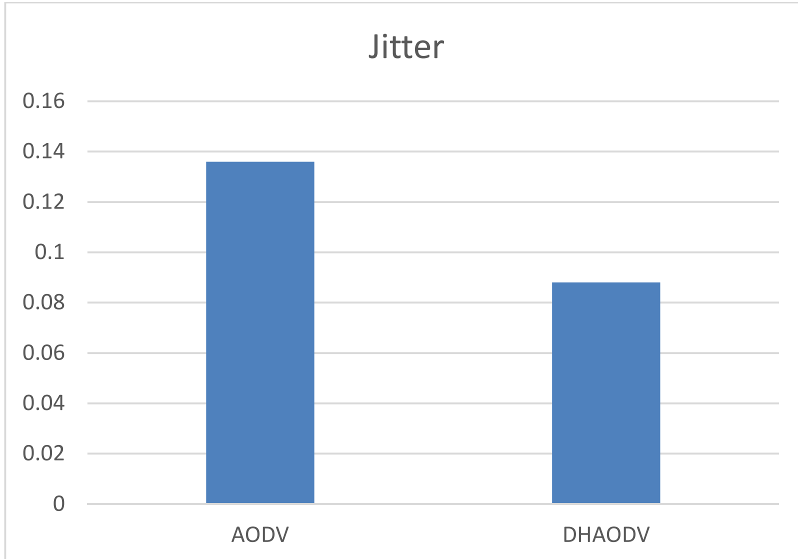


Figure 4.Jitter Output

CONCLUSION

This paper presents the DH-AODV routing protocol which is proposed to enhance the performance of the hybrid WMNs by reducing the number of the RREQ packets flooding the network and choosing the reverse path from the gateway to the destination node base on the sequence number of the nodes in addition to the hop count. The proposed routing protocol was tested and evaluated using QualNet simulator.

REFERENCES

[1] Kapadia, K.N.; Amba wade, D.D., "Congestion aware load balancing for multi radio Wireless Mesh Network," in *International Conference onCommunication, Information & Computing Technology (ICCICT, 2015)*, pp.1-6, 15-17 Jan. 2015.

[2] I.Akyildiz, X. W. Wireless Mesh Networks: a survey. Computer Networks , 47, no. 4, 2005, p. 225-487.

[3] R. Bruno, "Mesh Networks: Commodity Multihop Ad Hoc Networks". IEEE Communications Magazine , vol. 43, no. 3, 2005, pp. 123 – 131.

[4] Ann Lee, Paul Ward, “A Study of Routing Algorithms in Wireless Mesh Networks”. Australian Telecommunication Networks and Applications Conference. December, 2004. pp 49-58.

[5] Asad A. Pirzada, M. P. “Hybrid Mesh Ad-hoc On-demand Distance Vector Routing Protocol”. the Thirtieth Australasian Computer Science Conference, 2007, Pp 45-51.

[6] S. Gwalani, E. M. Royer, and C. E. Perkins. AODV-PA: AODV with Path Accumulation. In IEEE International Conference on Communications, volume 1, 2003, pp. 527–531.

[7] K. Ramachandran, M. Buddhikot, G. Chandranmenon, S. Miller, E. Belding-Royer, and K. Almeroth. On the Design and Implementation of Infrastructure Mesh Networks. In Proceedings of the IEEEWorkshop onWireless Mesh Networks (WiMesh), pages 4–15. IEEE Press, 2005.

[8] Rachel de C. Paschoalino, E. R. “A Scalable Link Quality Routing Protocol for Multi-radio Wireless Mesh Networks”. in IEEE ICCCN 2007, Honolulu, Hawaii, USA. 2007-2008.

[9] Asad Amir Pirzada, M. P. “Evaluation of Multi-Radio Extensions to AODV for Wireless Mesh Networks”. MobiWac’06. 2006

[10] Anh Ngoc Le, Dong-Won Kum, Sung-Hyup Lee, You-Ze Cho, In-Soo Lee, “Directional AODV Routing Protocol for Wireless Mesh Network.” The 18th Annual IEEE International Symposium on Personal, ndoor and Mobile Radio Communications. *CIMRC07*, 2007, pp 1-5.

11] Samba S., “Simulation Comparison of Four Wireless Ad hoc Routing Protocols”. Information Technology Journal , 3, 2004. pp. 219-226.

[12] Klein-Berndt, “A Quick Guide to AODV Routing.” Wireless Communications Technologies Group National Institute of Standards and Technology. 2003.