AUTONOMOUS NETWORK RECONFIGURATION SYSTEM WITH CA-AOMDV IN WIRELESS MESH NETWORKS

G.R.Ezhil*

S.Muthukumar**

Abstract:

Wireless mesh networks (WMNs) have emerged as a key technology for next-generation wireless networking. Because of their advantages over other wireless networks, WMNs are undergoing rapid progress and inspiring numerous applications. WMN is a promising wireless technology for numerous applications e.g., broadband home networking, community and neighbourhood networks, enterprise networking, building automation, etc. It is gaining significant attention as a possible way for cash strapped Internet service providers (ISPs), carriers, and others to roll out robust and reliable wireless broadband service access in a way that needs minimal up-front investments. Also there occurs some link failures which degrade the performance of the WMNs. In this paper, we have made use of Autonomous Network Reconfiguration System(ARS) and to route the packets we have used Channel Aware Ad-hoc On-Demand Multipath Distance Vector (CA-AOMDV) for route selection. Through our experimental results, it is known that the ARS along with CA-AOMDV enhances the performance of WMNs in times of link failures in the network.

Keywords: self reconfigurable networks, link failures, multi-radio wireless mesh networks, routing, routing protocol.

* Dept. of Information Technology, PSN College of Engineering and Technology, Tirunelveli, India.

** Asst professor, Dept. of Information Technology, PSN College of Engineering and Technology, Tirunelveli, India.

I.INTRODUCTION:

The term **'wireless mesh networks'** [1] describes wireless networks in which each node can communicate directly with one or more peer nodes. The term '**mesh**' originally used to suggest that all nodes were connected to all other nodes. Wireless mesh network is dynamically self configured and self organized, with nodes in the network automatically establishing and maintaining mesh connectivity among themselves. Still, this is quite different than traditional wireless networks, which require centralized access points to mediate the wireless connection. Each node in the WMN operates not only as a host but also as a router. Based upon the functionality of nodes, the architecture of WMN can be classified into three broad categories. First, infrastructure or backbone WMNs which includes mesh routers forming an infrastructure for clients that connect to them. Second, client WMNs which allows peer-to-peer networking among client devices. Third, hybrid WMNs which is nothing but the combination of previously prescribed infrastructure and client WMNs. Obviously the WMN bears few important characteristics with some distinguishable features. These characteristics may include multi hop, non line of sight connectivity, capability of self forming, self healing and self organization, mobility dependence based on the type of mesh nodes, multiple types of network access. Based on these characteristics WMNs can be considered as a type of ad hoc networks. To be more specific WMNs tries to diversify the capabilities of ad hoc networks. Few differences that may be pinpointed between WMNs and ad hoc networks are : first, in ad hoc networks end user devices perform routing and configuration functionalities whereas in WMNs the mesh routers responsible for this task; second, in ad hoc networks the network topology and connectivity depends on the movement of users thereby imposing additional challenges regarding the routing issues. Regarding the application areas the WMNs are used in broadband home networking, community and neighbourhood networking, enterprise networking, metropolitan area networking, transport systems, health and medical systems, security surveillance systems and so on. In WMNs link failures degrade its performance. Normally link failure can be detected when one of the failure such as self failure (node’s self crash or reboot or connectivity issues or bug in software code), path failure (collision along the path), sink failure (base station failure due to bad placement of the base station or connectivity issues) occurs in the network. In our proposed system we just help the WMN to self configure itself during the link failures by introducing the Autonomous Network Reconfiguration System (ARS) in section III .

II. PREVIOUS WORK:

Ramachandran in his paper [3] presents an interference-aware channel assignment algorithm for addressing the channel assignment problem by utilizing Optimized Link State Routing (OLSR) protocol and Weighted Cumulative Expected Transmission Time (WCETT) as route selection metrics. The author concludes in his paper [3] that BFS-CA improves the performance of wireless mesh networks by minimizing interference between routers in the mesh network and between the mesh network and co-located wireless networks. Mansoor in his paper [4] has formulated the joint channel assignment and routing problem, considering the interference constraints, number of channels in the network and the number of radios available at each mesh router that models the interference and fairness constraints. The author introduces a Constant Factor Approximation Algorithm which performs better in worst case bounds is known through the experimental results. Nelakuditti in his paper [13] ha introduced a link-state-based blacklist-aided forwarding (BAF) approach, that takes advantage of the fact that the nodes and therefore their adjacencies are relatively static, for scalable packet delivery in static wireless networks. This approach aims to balance the trade-offs in reliability (high packet delivery rate), optimality (routing along the best quality paths) and scalability (routing overheads) by taking advantage of the unique characteristics of static multi-hop mesh networks.

The rest of this paper is organized as follows. We introduce CA-AOMDV routing protocol for routing packets in WMNS and also make use of Autonomous Network Reconfiguration System in order to enable self reconfigure during link failures which is described in section III. In section IV, we present the simulation results. In section V, we conclude with our findings regarding the new approach.

III. PROPOSED SYSTEM:

In the proposed system we give the overall design and algorithm of ARS along with the routing algorithm CA-AOMDV.

A. Autonomous Network Reconfiguration System (ARS):

This allows a multi-radio WMN (mr-WMN) to autonomously reconfigure its local network settings i.e. channel assignment, radio assignment and route assignment for real-time recovery from link failures. Some of the known features that make the ARS architecture to be distinct from other network architectures are localized reconfiguration, QoS-aware planning, autonomous reconfiguration via link-quality monitoring and Cross-layer interaction. To be more specific, ARS can maintain connectivity even during the recovery period with the help of the routing protocol. In this paper, the author uses the CA-AOMDV routing protocol. The algorithm of the ARS [22] is as follows,

Algorithm 1: ARS Operation at mesh node *i*

(1) Monitoring period(tm)

1: **for every** link j **do**

2:measure link-quality using passive monitoring;

3: **end for**

4: send monitoring results to a gateway g ;

(2) Failure detection and group formation period(tf)

5: **if** link violates link requirements r **then**

6: request a group formation on channel c of link l ;

7: **end if**

8: participate in a leader election if a request is received;

(3) Planning period (M ,tp)

9: **if** node i is elected as a leader **then**

10: send a planning request message (c,M) to a gateway;

else if node i is a gateway **then**

synchronize requests from reconfiguration groups Mn

generate a reconfiguration(p) plan for Mi ;

send a reconfiguration plan p to a leader of Mi ;

end if

(4) Reconfiguration period (p,tr)

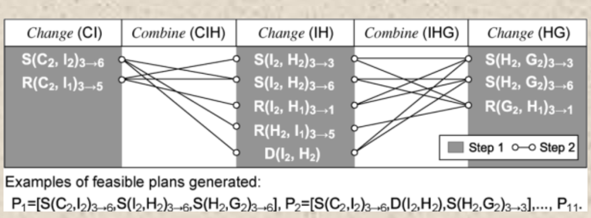
if includes changes of node i **then**

apply the changes to links at t;

end if

relay p to neighbouring members, if any

Algorithm 1 describes the operation of ARS. First, ARS in every mesh node does a passive monitoring of the quality of its outgoing wireless links at every tm i.e. monitoring period. Second, ARS does a fault detection and then triggers the formation of a group among local mesh routers, and a leader is chosen using the well-known bully algorithm [24] for coordinating the reconfiguration. Third, ARS does a planning via the leader node which sends a planning-request message to a gateway which in turn synchronizes it. Fourth, is the generation of reconfiguration plan which the gateway sends to the leader and to all the group members' gateway sends a reconfiguration plan to the leader node and the group members. Finally, all nodes in the group execute the corresponding configuration changes, if any, and resolve the group. Here as stated in the algorithm the reconfiguration plan is defined as a set of links' configuration changes like channel switch, link association etc necessary for a network to recover from a link(s) failure on a channel. ARS as always derives a reconfiguration plan that satisfies the Qos constraints in the most successful manner.



For each and every plan generated the ARS determines whether the Qos constraints are met through per-link bandwidth estimation, examining the per-link bandwidth satisfiability and also during this cascaded link failures must be avoided.

B. Channel Aware Ad-hoc On-Demand Multipath Distance Vector(CA-AOMDV)

The term routing is defined as the process of choosing a path over which the packets are sent. Routing is mainly classified as static routing and dynamic routing. We have learnt that AODV [2] is a single-path, on-demand routing protocol where the routing decisions will be taken depending on the number of hops to destination. There also arise drawbacks regarding this protocol such as : first, intermediate routes can lead to inconsistent routes; Second, more bandwidth consumption. But when we come across the routing protocol, Ad-hoc On-Demand Multipath Distance Vector (AOMDV), it is understood that this protocol provides multi path decision making regarding the packet transfer from the source to destination. There also arise shortcomings with AOMDV protocol such as only the hop count is used for making path decisions. In our proposed system, CA-AOMDV as it combines channel assignment with AOMDV.

IV. RESULTS AND DISCUSSION:

We have simulated our proposed system using NS2 simulator tool[22]. For simulation, we have used a grid topology with exactly 8 nodes in an area of 1 × 1 km . In this topology, the separation between the adjacent nodes is 200 m, and each node is equipped with a different number of radios, depending on its proximity to a gateway. The gateway is equipped with four radios, one-hop away nodes from a gateway have three radios, and other nodes have two radios.

The operating system needed is Linux, RAM is 512MB, Monitor is 15 VGA color. Each packet transmitted has a size of 1000 bytes.

V. CONCLUSION:

This paper has presented an autonomous network reconfiguration system that enables wireless mesh networks to recover from link failures on their own i.e. by itself. Through experimental results it is obvious that the Autonomous Network Reconfiguration System along with Channel Aware Ad-hoc On-Demand Multipath Distance Vector routing protocol has improved the performance of wireless mesh networks further to greater heights when compared to the existing approaches. Also our new approach could minimize the delays that occur in the time of link failures in the network.

REFERENCES:

- Ian F. Akyildiz , Xudong Wang and Weilin Wang "Wireless mesh networks: a survey"
- Elsevier, Computer Networks (45) pp 445-487, 2005
- Klein-Berndt, L. "A Quick Guide to AODV Routing", Wireless Communications Technologies Group, NIST (http://w3.antd.nist.gov/wctg/aodv_kernel/
- K. Ramanchandran, E. Belding-Royer, and M. Buddhikot, "Interference-aware channel assignment in multi-radio wireless mesh networks," in *Proc. IEEE INFOCOM*, Barcelona, Spain, Apr. 2006, pp. 1–12.
- J. Zhao, H. Zheng, and G.-H. Yang, "Distributed coordination in dynamic spectrum allocation networks," in *Proc. IEEE DySPAN*, Baltimore, MD, Nov. 2005, pp. 259–268.
- M. Alicherry, R. Bhatia, and L. Li, "Joint channel assignment and routing for throughput optimization in multi-radio wireless mesh networks," in *Proc. ACM MobiCom*, Cologne, Germany, Aug. 2005,pp. 58–72.
- M. Kodialam and T. Nandagopal, "Characterizing the capacity region in multi-radio multi-channel wireless mesh networks," in *Proc. ACM MobiCom*, Cologne, Germany, Aug. 2005, pp. 73–87.
- C. E. Perkins, "Ad hoc on demand distance vector (AODV) routing," IEFT Internet Draft, November 1998, http://www.ieft.org/internetdrafts/draft-ietf-manet-aodv- 02.txt.

- C. E. Perkins and P. Bhagwat, "Highly dynamic destination sequenced distance vector routing (DSDV) for mobile computers," Proceedings of ACM SIGCOMM' 94, London, UK, pp. 234–244, August– September 1994.
- D. B. Johnson, D. A. Maltz, and J. Broch, "Dynamic source routing for multihop wireless ad hoc networks," in Ad Hoc Networking, edited by Charles E. Perkins, Addison-Wesley, Chapter 5, pp 139–172, 2001
- V. Park and S. Corson, "Temporally-ordered routing algorithm (TORA) Version 1 functional specification," IETF Internet Draft, work in progress, draft-ietf-manettora- spec-04.txt, 2001
- A. Brzezinski, G. Zussman, and E. Modiano, "Enabling distributed throughput maximization in wireless mesh networks: A partitioning approach," in *Proc. ACM MobiCom*, Los Angeles, CA, Sep. 2006, pp. 26–37
- A. Raniwala and T. Chiueh, "Architecture and algorithms for an IEEE 802.11-based multi-channel wireless mesh network," in *Proc. IEEE INFOCOM*, Miami, FL, Mar. 2005, vol. 3, pp. 2223–2234
- S. Nelakuditi, S. Lee, Y. Yu, J. Wang, Z. Zhong, G. Lu, and Z. Zhang, "Blacklist-aided forwarding in static multihop wireless networks," in *Proc. IEEE SECON*, Santa Clara, CA, Sep. 2005, pp. 252–262
- S. Chen and K. Nahrstedt, "Distributed quality-of-service routing in ad hoc networks," *IEEE J. Sel. Areas Commun.*, vol. 17, no. 8, pp.1488–1505, Aug. 1999
- L. Qiu, P. Bahl, A. Rao, and L. Zhou, "Troubleshooting multi-hop wireless networks," in *Proc. ACM SIGMETRICS*, Jun. 2005, pp. 380–381
- M. Buddhikot, P. Kolodzy, S. Miller, K. Ryan, and J. Evans, "DIMSUMnet:New directions in wireless networking using coordinated dynamicspectrum access," in *Proc. IEEE WoWMOM*, Naxos, Italy, Jun.2005, pp. 78–85
- D. S. D. Couto, D. Aguayo, J. Bicket, and R. Morris, "A high-throughput path metric for multi-hop wireless routing," in*Proc. ACM MobiCom*, San Diego, CA, Sep. 2003, pp. 134–146

- G. Holland, N. Vaidya, and P. Bahl, "A rate-adaptiveMAC protocol for multi-hop wireless networks," in *Proc. ACM MobiCom*, Rome, Italy, Sep. 2001, pp. 236–251
- A. P. Subramanian, H. Gupta, S. R. Das, and J. Cao, "Minimum interference channel assignment in multiradio wireless mesh networks,"*IEEE Trans. Mobile Comput.*, vol. 7, no. 12, pp. 1459–1473, Dec. 2008
- K.-H. Kim and K. G. Shin, "On accurate and asymmetry-aware measurement of link quality in wireless mesh networks," *IEEE/ACMTrans. Netw.*, vol. 17, no. 4, pp. 1172–1185, Aug. 2009
- H.Wu, X.Wang, Y. Liu, Q. Zhang, and Z.-L. Zhang, "SoftMAC: Layer 2.5 mac for VoIP spport in multi-hop wireless networks," in *Proc. IEEE SECON*, Santa Clara, CA, Sep. 2005, pp. 441–451
- "The network simulator—ns-2," [Online]. Available: http://www.isi.edu/nsnam/ns
- Kyu-Han Kim and Kang G. Shin "Self Re-Configurable Wireless Mesh Networks " IEEE/ACM Transactions on Networking, Vol. 19, No. 2, April 2005
- A. S. Tanenbaum and M. V. Steen, *Distributed Systems*. Upper Saddle River, NJ: Pearson Education, 2002.