Autonomously-Reconfigurable Wireless Mesh Networks

C. M. Jadhav, Rucha Dilip Patil

Abstract: Multi-hop wireless mesh network experience link-fail due to channel interference (i/f), dynamic obstacles etc. which causes performance degradation of the network in Wireless Mesh Networks. The paper proposes "The base of Autonomously Reconfigurable Wireless Mesh Networks system is IEEE 802.11" for mr-WMN to recover autonomously when the network failure occurs & to improve the performance of network. The paper uses an autonomously network reconfiguration system (ARS) algorithm to maintain network performance that allows a multi radio WMN to own recover from local link failure. ARS generates needful changes in local radio and channel assignments in order to recover from failures by using channels and radio variability in WMN's. Next, the system cooperatively reconfigures network setting among local mesh routers based on the generated configuration changes.

Keywords: IEEE 802.11, multi-radio wireless mesh networks (mr-WMNs), Autonomous-Reconfigurable Network, Wireless Link Failures.

I. INTRODUCTION

A wireless mesh networks: (WMN) is a communications network made up of radio nodes Organized in a mesh topology. Wireless mesh networks consisting of mesh routers, Gateways and mesh clients. The mesh clients like laptops, mobile node and other wireless devices also mesh clients can work as router. The mesh routers send networks traffic and the gateways which may connect to the Internet [1]. It is supports larger applications and also it provides some benefits to workstations such as no cabling cost, automatic connection for all nodes, network flexibility, ease of installation and it also discovers new routes automatically.

Wireless mesh networks (WMNs) are not stand alone they are connected with other wireless networks through mesh routers. It provides much greater range of data transfer rates in the networks. Wireless mesh networks protocols are used for communication at small amount cost. So that here is more chances of failure link and packet losses. Information transmission for WMNs are generally started from the specific source node to their specified destination node [3]. The range transmission strategies can be similar for different kinds of networks. In wireless mesh networks failure link occurs because of increases the application bandwidth demand, different channel interference and dynamic obstacles. Even though various solution for wireless mesh network WMNs to recover from wireless link failures has proposed such as resource-allocation algorithm, Greedy channel assignment algorithm and fault-tolerant routing protocols [2].

First is resource-allocation algorithm are allocates the resources initially, also can used for initial network planning only theoretical guidelines. The disadvantages is that they provide optimal solution for require the global configuration changes, which is not suitable for the sequentially link failures occurs. Next, a greedy channel assignment algorithm can change the settings of only the faulty links. The disadvantage is that we need to consider the faulty link(s) along with configurations of neighbor nodes in mesh. Third, fault-tolerant routing protocols, it can be used for replacing the faulty links in routing protocol for local re-routing, multipath routing. This fault-tolerant routing protocol depends on repetition transmission, it uses for more amounts of network resources than the reconfiguration in link-level network [2][5].

To overcome the above mentioned limitations this paper presents an autonomous network reconfiguration system (ARS) that allows multi-radio WMN (mr-WMN) autonomously reconfigure local network settings. To maintain the strong networks using autonomous network reconfiguration system(ARS). Reconfiguration planning algorithm consisting of ARS, will find the configuration changes in local network for recovery, so that it reduces the changes in healthy network. Initially ARS searches for local reconfiguration changes that are available for faulty area. To perform real-time recovery form failures autonomously reconfiguration system also supervising the protocol that enables a WMN. It also prevents the ripple effects. The protocol run in each mesh node and simultaneously measure wireless link conditions. Calculate the failure of link and generates the reconfiguration plan for measuring the information of ARS. The rest of this is arrange as follows, Section II related work Section III describe ARS Architecture, IV Concludes the paper.

II. RELATED WORK

A considerable amount of works has done for solving the problem in WMNs and maintaining the healthy networks. And Networks reconfiguration used a planning algorithm that keeps necessary network changes (to recover from link failures) local as possible as opposed to

change in related network settings. Scheduling algorithms and existing channel assignment provide guidelines such as throughput bounds and schedule ability for channel assignment during a network deployment stage. Brief study to develop practical algorithms & to solve problems of wireless mesh networks also they have discussed various theories to solve these problems provides the paper by A. Brzezinski, G. Zussman, and E.Modiano, [2] .A survey paper by IAN F.

Revised Version Manuscript Received on March 03, 2017.

Prof. C. M. Jadhav, Professor & Head, Department of Computer Science & Engineering, Bharat Ratna Indira Gandhi College of Engineering, Kegao, Solapur (Maharashtra). India.

Rucha Dilip Patil, ME, Department of Computer Science & Engineering, Bharat Ratna Indira Gandhi College of Engineering, Kegao, Solapur (Maharashtra). India. E-mail: ruchadpatil@gmail.com

Akyildiz, Georgia [3] gives a brief survey of wireless mesh networks. The authors of this paper give emphasis on architectural design of WMNs, layered communication in network and security. New Autonomous System for WMN [4] the author have suggested a new Autonomous System for WMNs.

He proposes this as for WMN to reduce manual configuration of network which solve failure recovery problems. The Quality of service (QoS) requirement of network is also fulfilled. As discussed above there are some problems in WMNs, a research by Kyu-Han kim and Kang G. shin [5] suggested a self- reconfigurable WMNs. The authors claim to solve the above discussed problems. We are extending our work from this paper.

III. ARS ARCHITECTURE

A. Architecture

The figure 1 Shows architecture of autonomously reconfigurable wireless mesh network.ARS is used for collect and sends the packets related to ARS similar to the group formation information. For this module in which it include algorithm and related protocols of ARS[4][5].The information related to links in wireless mesh networks is provided by link status and network controller resides in device driver and interacts with failure finder in the algorithm [6].

1. Failure Finder interacts frequently with network monitor and with device driver and maintain information about updated link state table.
2. Formation of local groups within mesh networks is designed by Group organizer.
3. Planner Gateway- It is used for generating the network reconfiguration plan only for gateway nodes. The planner gateway includes plan producer, QoS filter and Benefit filter to generate plan.
4. NIC setting administrator receives new plan from group organizer and uses this new plan

for further communication in the wireless mesh networks.

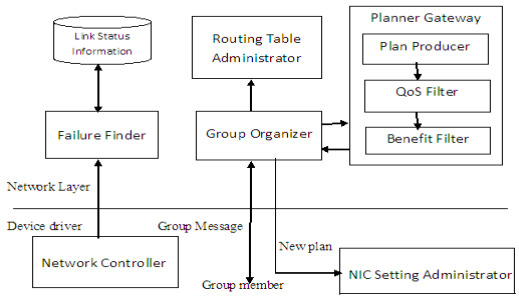

Fig 1. ARS Architecture

B. ARS Algorithm

1) Network Controller Time (tc)

1: For every link l do

2: calculate link quality(lq) using passive monitoring

3: end for

4: Send controlling result to a gateway g;

2. Failure Finder and Group Organization Time (to)

5: if link l disconnect link requirement r then

6: request group organization on channel c of link l;

7: end if

8: start a leader election if it is receiver a request

3. Planning Time (C,tp)

9: if node x is elected as leader then

10: send planning request message(m,C) to gateway

11: generate a reconfiguration plan(p) to Cx;

12: send a reconfigplan (p) to a leader of Cx;

13: end if

4. Reconfiguration Time (p, tr)

14: if p has changes of node x then

15: apply changes to link at t;

16: end if

17: relay p to neighboring members, if any

First, ARS in every mesh nodes checks the outgoing links quality and sends result to a gateway by sending messages. Second, if it detects a link failures, ARS in the detector node trigger the group formation within local mesh routers and one group member becomes leader using election algorithm for coordinating reconfiguration. Third, leader sends a planning request message to a gateway then the gateway generate reconfiguration plan for the request. Forth, the gateway sends reconfiguration plan to leader node and the group members and Finally all nodes in group execute the new plan, if any, and resolve the group[5][7].

IV. IMPLEMENTATION RESULTS

User Interface

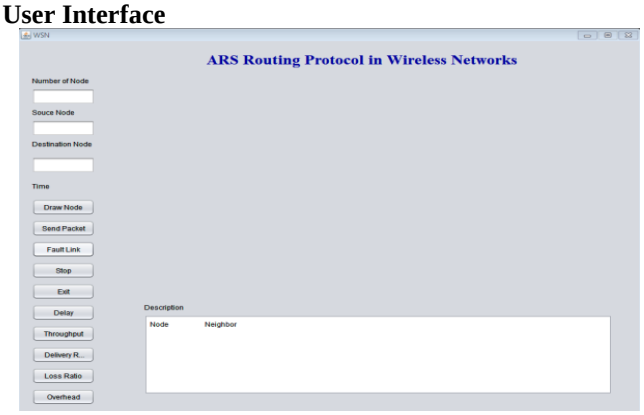

Fig: 2 User Interface

The proposed GUI is shown in figure 2. Three kinds of inputs are taken from the user as follows:

Number of Nodes- Number of Nodes shows the count of nodes participating in communication forms the wireless mesh network.

Source Node-This is the index of node (identifier) of node wants to send data packet to the destination present in the wireless mesh network.

Destination Node-This is the index of node intended to receive data packets from the source node.

There are several commands of events may occurs from the user during the execution of the system. The events are as follows:

Draw Node- Draw node event is used to create and shows wireless mesh network of number of nodes given in the input.

Send Packet- Send packet event causes transmission of data packet from the source to destination as given in the input. If the destination node is in the transmission range of source node, source will transmit the data packet directly without any intermediate node. But, if the destination node is not in the transmission range of source node, source will transmit the data packet to the next intermediate hop present on the possible shortest route towards the destination.

Now, every intermediate node follows the same idea to deliver the data packet up to the destination node. The successive data packets will take the same route followed by transmission of first packet.

Fault Link- This event is mainly used to simulate the occurrence of link failure in wireless mesh network. When link failure occurs the system will automatically reconfigures the route from the node at which fault occurs up to the destination node. The reconfiguration finds the next possible shortest route available and transmits the remaining data packets till the next link failure occurs.

Creation of Nodes.

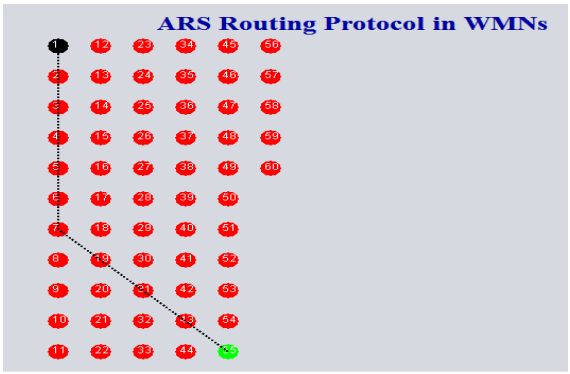

Figure 3: Creation of Wireless Mesh Network

The above figure 3 shows the wireless mesh network of 60 nodes. The nodes with identifier 1 and 55 in figure are configured as a source node Creation of Wireless Mesh Network and destination node respectively. The dotted line shows the transmission path (2-3-4-5-6-7-19-31-43) of data packets from the source node to the destination node. The nodes 2,3,4,5,6,7,19,31 and 43 are the intermediate nodes present along the transmission path between source (Node 1) and destination node (Node 55).

A. Link Failure and Reconfiguration of Path

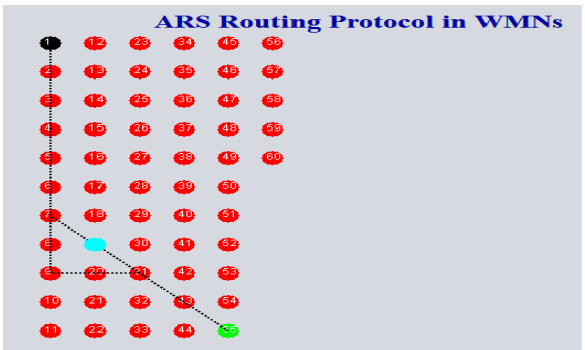

Fig: 4 Link Failure and Reconfiguration of Path

As shown in figure 4 the fault occurs at node with index 19, which leads to stop the transmission of packets. Immediately, the system will reconfigures the route from the predecessor (Node 7) of the node at which the fault occurs, up to the destination node. The remaining data packets will take the newly reconfigure route (7-8-9-20-31-43-55) to reach to the destination node. This technique will not allow the packet delivery ratio (PDR) to get down.

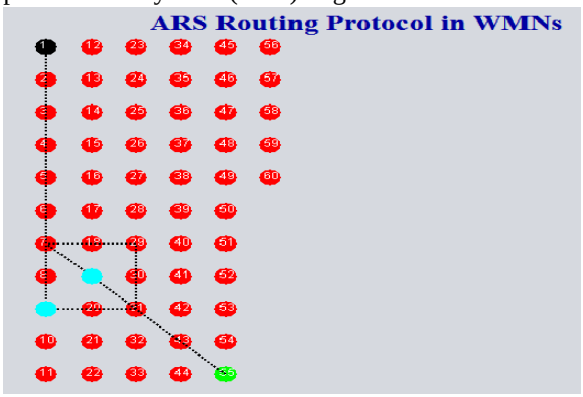

Fig: 5 Successive Link Failure and Reconfiguration of Route

Above figure 5 shows the second link failure at the node (index 9). By following the same reconfiguration technique, the system calculates the next alternative path (7-18-29-30-31-43-55).

V. CONCLUSION

This paper presents Autonomous Reconfiguration System (ARS) that helps a WMNs to reconfigure autonomously from link failure. Also ARS helps in generating reconfiguration plan. ARS implements the reconfiguration plan, which satisfies QoS constraint. User interface for application deployment.

REFERENCES

1. Akyildiz, X. Wang, and W. Wang, "Wireless mesh networks: Survey," Comput. etw., vol. 47, no. 4, pp. 445–487, Mar. 2005.
2. 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.
3. F. AKYILDIZ, GEORGIA INSTITUTE OF TECHNOLOGYXUDONG WANG, KIYON, INC.A "Survey on Wireless Mesh Networks"
4. P. S. Khanagoudar "A New Autonomous System (AS) for Wireless Mesh Network", JEITVol 2, Issue 1, july 2012.
5. kyu-Han kim, Member, IEEE and Kang G. Shin " Self-Reconfigurable Wireless MeshNetwork", IEEE ACM TRANSACTION ON NETWORKING, VOL 19.NO.2, April 2011.
6. Jensilin Mary A, "Autonomously Reconfiguring Failure in Wireless Mesh Network",Journal of Computer Application ISSN, Vol-5, EICA 2012 Feb 10
7. R. Draves, J. Padhye, and B. Zill, "Routing in multi-radio, multi-hop wireless meshnetworks," in Proc. ACM MobiCom, Philadelphia, PA, Sep. 2004, pp. 114–128.
8. Raniwala and T. Chiueh, "Architecture and algorithms for an IEEE 802.11-basedmulti- channel wireless mesh network," in Proc. IEEE IN-FOCOM, Miami, FL, Mar. 2005,vol. 3
9. Xiao Shu, Xining Li, "Link Failure Rate and Speed of Nodes in Wireless Network", Computingand Info. SCi. University Canada, 2008 IEEE.
10. L.Qiu, P.Bahl,A. Rao, and L. Zhou, "Troubleshooting multi-hop wireless networks," in Proc. ACM SIGMETRICS, Jun. 2005, pp. 380–381.
11. P. Kyasanur and N. Vaidya, "Capacity of multi-channel wireless networks: Impact ofnumber of channels and interfaces," in Proc. ACM Mobi Com, Cologne, Germany, Aug. 2005, pp. 43–57.