Reconfiguring Wireless Mesh Network Using Link Recovery Technique

Kalyani Pendke
M.E. (Wireless Communication & Computing),
Dept. of Computer Science & Engg, G.H.Raisoni College of Engg,
Nagpur,India

S.U.Nimbhorkar
Assist.Professor
Dept. of Computer Science & Engg., G.H.Raisoni College of Engg.,
Nagpur,India,

Abstract— **Now a days , Wireless Mesh Networks (WMNs) have become very popular technology for Wireless Communication. But during their working period wireless mesh networks are severely affected because of the frequent link failures. This failures are caused by various factors like interference, obstacles in motion and bandwidth requirements of the application. This paper converse about various methods for detection of link failure and the methods used for reconfiguration of Wireless Mesh Network(WMN). Paper also include the information about system which provides cost aware reconfiguration scheme that enables WMNs to recover from link failures. The system monitors the quality of links of each node & generate all possible reconfiguration plans. It will consist of four phases , Generation of feasible plan , QoS test , Cost analysis & Selection of optimal plan. To improve the performance of wireless mesh network using cost aware technique the use of routing agent is performed. This routing agent decides when to apply the reconfiguration plan. Because of the use of routing agent the reconfiguration of WMN is successfully performed by considering the cost aware technique.**

Keywords- **Quality of Service (QoS) , Wireless Mesh Network(WMN) , Enhanced Reconfiguration System (ERS) .**

Introduction

Now a days Wireless technology has become very important component of networking. Wireless Mesh Network. is very popular wireless technologies. A node in WMNs can be simple receive send node, and can also function as router and can relay message to its neighbor. With its advantageous features of low cost, high scalability, easy maintenance and reliable services, WMNs are a natural solution to the broadband communication demands in rural communities where wired-backbone infrastructure is virtually non-existent. WMNs typically consist of access points (AP), wireless mesh routers and clients [1].

Wireless Mesh Network are specially design to resolve the drawbacks of earlier communication network like ad hoc network, Wireless Sensor Network (WSN). The best advantage of Wireless Mesh Network is it's ability of self-organization & self-configuration . Access points (AP), mesh routers and mesh clients are essential components of Wireless Mesh Networks (WMNs) . Mobility of mesh router is minimum as compared to mesh client. Every node of Wireless mesh network act as a simple receive and send node, where it can relay the message for its neighbored node. Wireless Mesh Networks are used to provide broadband communication services in rural areas where establishment of wired communication network is extremely difficult.

Wireless Mesh Network comprised of two types of nodes: mesh routers and mesh clients. A wireless mesh router uses some additional routing functions to support mesh networking. A mesh router is generally equipped with multiple wireless interfaces built on either the same or different wireless access technologies to improve the flexibility of Wireless Mesh Network. A wireless mesh router can achieve the same coverage with much lower transmission power through multi-hop communications when it has been compared with conventional wireless router [2].

Deployment of WMN is relatively simple as compared to other types of communication network. Wireless Mesh Network can be deployed in increasing manner as and when it is required. As more number of nodes are present in network, it improves the overall performance of network by increasing the connectivity in network. Existing MAC layer protocols does not perform well in case of Wireless Mesh Network. Researchers have started their work to perform the modifications in existing MAC layer protocols so that they can be applied more efficiently to Wireless Mesh Network. Researchers are also focusing on the structure of ad-hoc networks, Wireless Sensor Network , IEEE 802.11 networks with perspective of Wireless Mesh Network. [3].

Administration of Wireless Mesh Network is complex as compared to management of wired network. The reason for this complexity is the constraints on network resource and variable nature of wireless link. Because of this reason the techniques used for monitoring wired network can not be applied to Wireless Mesh Network. There are less solutions available for managing Wireless Mesh Network .The solutions which are available are very costly which reduces it's use in small project [4].

Reconfiguration of Wireless Mesh Network plays important role in improving the overall performance of WMN in case of link failure. The proposed system will perform the cost aware reconfiguration of Wireless Mesh Network . More precisely, the proposed system detects the faulty link and then performs link recovery by using cost aware reconfiguration technique.

The rest of this paper is structured as follows. Section II presents the related work. Section III describes the information about proposed work. Section IV presents the result. Section V draws conclusion of paper.

II. RELATED WORK

The communication over Wireless Mesh Network may suffer from various problems like link failure, interference etc. When the link failure occurs , the data on that link also get lost. Hence the time passed during failure of link and it's detection plays very important role in communication of Wireless mesh Network. This time should be as small as possible. This increases the reliability of communication over WMN. After detection of link failure , the routing protocol selects the alternative path for forwarding data packets. The alternative path is selected so that the communication over WMN can continue in smooth manner. Fast detection of link failures plays important role in increasing the overall performance of the network [5].

The two main reasons for causing the link failure in Wireless Mesh Network are failure of node and degradation of link quality. The surrounding environment has great effect on quality of link. Interference occurring in communication channel and mobility of node has large impact on quality of link.

A. Link Failure Detection

Detection of link failure plays important role in improving the performance of network. Two approaches are widely used for link failure detection they are Neighbor discovery mechanisms and Cross layer approaches.

1) Neighbor Discovery Approach

In pro-active link state routing protocol , every node find it's neighbored node by using periodic HELLO message which is also used to establish the link with neighbored node. This information is spread across whole network. If any node discover failed link then this information is spread across whole network so that the invalid root should not be used during communication.

In re-active routing protocols , a route determination process is always on-demand when a communication starts. In this process the active link failure is also determined with the help of HELLO messages.

Neighbor discovery mechanism works as follows : Nodes in the network send HELLO messages periodically to all it's neighbor in its communication range. If number of HELLO messages are successfully received on link then that link is assumed to be in active state and can be used for routing. If the link failed to receive any message over the link for certain period of time then that link is assumed to be broken. Neighbor Discovery Mechanism is not suitable for time critical applications [6].

2) Cross-layer Approach

The possibility of error during communication performed in wireless medium is more as compared to wired medium. Hence a retransmission mechanism is used in IEEE 802.11 MAC layer to make it more reliable. The concept of acknowledgement for reception of unicast MAC frame is used in order to detect the various types of transmission error. Retransmission of frame is performed in absence of acknowledgement for that frame. After performing the retransmission of frame certain number of times the frame is discarded. And delivery is assumed to be failed. The link failure is determined by considering the information about transmission errors and information about failed delivery in MAC layer.

B. Schemes Used for Reconfiguration of WMN

The approaches used for reconfiguration of WMN can be classified in three main classes protection schemes , restoration schemes and hybrid schemes.

The Protection Schemes works as follows: Two or more than two links are selected between source node and destination node. Source node send data on all of the selected paths , if any of the link is broken on selected path still destination node receive data through another path.

Restoration Schemes show better performance than Protection Schemes . After detection of link failure , it dynamically changes its path from failed path to the backup path . Some amount of delay has been introduced in restoration schemes , so it must balance between the capacity improvement and speed of network.

Hybrid schemes uses the restoration schemes after failure of protection schemes [7].

1)Initial Resource Allocation Techniques

Initial Resource Allocation Techniques gives the theoretical procedure for initial planning of all the network resources. The main drawback of this technique is that this techniques requires global configuration changes . During

frequent link failure , this techniques shows poor performance. Bhati, Li & Alcherry [8] gives the new method "Joint Channel Assignment Method". In this method , they uses the concepts of mathematics for dealing with various issues like channel assignment and routing problem.

2)Greedy Channel assignment Method

Greedy Channel Assignment Method improves the performance of previous reconfiguration techniques. In Greedy Channel Assignment Method the settings of only faulty link has been changed instead of changing other network settings. This reduces the need of global configuration changes. Raniwala and Chiueh [9] uses the greedy channel assignment approach which improves the performance of Wireless Mesh Network.

Greedy Channel Assignment Method has the drawback of "ripple effect". In ripple effect, if we make one local change then triggering of other network setting occurs. For obtaining better performance, the reconfiguration method should make the changes as local as possible.

3) Autonomous Reconfiguration System(ARS)

Kim and Shin [10] proposed a new method , Autonomous network Reconfiguration System (ARS).This technique allows Wireless Mesh Network to autonomously recover from link failure. ARS generates various reconfiguration plans for link recovery. The best plan is selected out of various reconfiguration plan which improves the overall network performance and maximizes throughput of network. The main limitation of ARS is that it is not a cost aware reconfiguration technique [11].

4) Enhanced Reconfiguration System(ERS)

Ramakrishnan R and Dr. N. Sankar [12] introduces Enhanced Reconfiguration System (ERS) which is a cost aware technique. In ERS , the n number of reconfiguration plan is generated then the plans are checked against various QoS constraints. In next step the cost of all plans are calculated and then best plan is selected which has minimum cost.

III. PROPOSED WORK

The proposed system is specially designed to provide cost aware reconfiguration scheme that enables WMNs to recover from link failures. The proposed system performs the monitoring of the quality of links between nodes . Based on measurement of link quality , it will generate all possible reconfiguration plans. The proposed system uses four phases , Feasible plan generation , Quality of Service (QoS) test , Cost analysis & Optimal plan Selection. Routing agent is used to improve the performance of wireless mesh network. The routing agent will decide whether to apply the reconfiguration plan or not. Some links are in frequent use while some of them are seldomly used. If the occasionally used links fails then there is no need to immediately apply the reconfiguration plan for it. The proposed system will keep the reconfiguration plan ready for rarely used links and will apply it when this type of link is needed for communication. With the use of routing agent, the link recovery technique become more cost aware. This type of system shows a great performance in the scenario where multiple link paths are available between nodes.

IV. RESULT

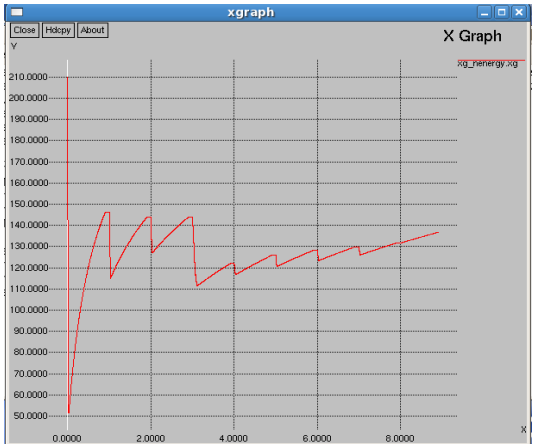

Fig 1 : Graph of Energy Before Applying Reconfiguration Algorithm.

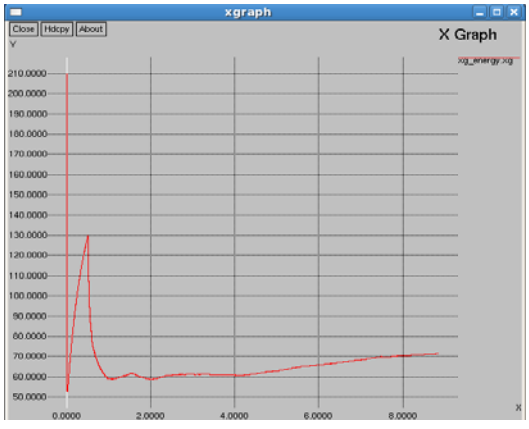

Fig 2 : Graph of Energy After Applying Reconfiguration Algorithm.

The above figure represents the graph of energy consumed by nodes of Wireless Mesh Network. On X-Axis the Time Parameter is taken and on Y-axis the Energy Parameter is taken. . In Fig (1) the average energy consumed by all the nodes is approximately 130 Joules. In Fig (2) the average energy consumed by all the nodes is approximately 70-80 Joules. From above graphs we can draw the inference that before applying the reconfiguration algorithm the energy consumed by nodes of Wireless Mesh Network is much higher than after application of reconfiguration algorithm. Hence the average life of overall network has been increased because of less consumption of energy. In this manner we have successfully performed the reconfiguration of wireless mesh network . The cost aware property of network has also been improved by improving the energy parameter of network.

V. CONCLUSION

This paper first presents detailed analysis of various schemes for link recovery in Wireless Mesh Network. For performing link recovery , detection of link failure is extremely important. For detection of link failure two main approaches , neighbor discovery mechanism and cross layer approach are discussed in paper . The paper gives the detailed knowledge about various reconfiguration techniques including Initial Resource Allocation Method , Greedy Channel Assignment Method , Autonomous Reconfiguration System(ARS) , Enhanced Reconfiguration System(ERS). Initial Resource Allocation Method has drawback of "Global Configuration Changes " . This problem is successfully handled in Greedy Channel Assignment Method. Ripple Effect , the problem with Greedy Channel Assignment Method is handled successfully in Autonomous Reconfiguration System. ARS is not a cost aware reconfiguration system. This difficulty is successfully handled in Enhanced Reconfiguration System(ERS). The proposed system improves the cost aware property of ERS by introduction of routing agent . This routing agent will decide when to apply the reconfiguration plan which again improves the cost aware property of ERS. The result in the form of graph is presented in last section of paper. Inference drawn from graph is that after application of reconfiguration of algorithm the energy consumption of nodes reduces considerably. And the reconfiguration of Wireless mesh network using link recovery technique is successfully performed.

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