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# An Effective Autonomous Reconfiguration System for Wireless Mesh Network

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**Abstract - In recent years, the demand for the network usage is increasing day by day. While transferring the data from source to destination, these networks experience frequent link failure which are caused by channel interference and dynamic obstacles, resulting in poor system performance. To preserve the network performance a Modified Autonomous Network Reconfiguration System is used, which identifies a link failure and enables a multi radio wireless mesh network to autonomously recover from the local link failure thus improving the QoS. Modified Autonomous Network Reconfiguration System is implemented extensively on IEEE 802.11b based WMN through NS2 simulation for mobile node configuration. The performance parameters of different recovery methods are analyzed and compared with modified autonomous system.**

**Keywords -** *Wireless Mesh Network, Reconfiguration System, Wireless Link Failures.*

## 1. Introduction

Wireless mesh networking (WMN) is an emerging technology that can be applied to provide cost-effective wireless coverage in a large area. These networks are boon to the wireless architecture [3]. It supports larger applications and it provides several benefits to users such as, no cabling cost, automatic connection to all nodes, network flexibility, ease of installation and it also discovers new routes automatically. These wireless mesh networks are not stand alone, it is compatible and interoperable with other wireless networks. It provides greater range of data transfer rates. Wireless mesh networks are preferable compared to the ad hoc networks for the ease of network maintenance, robustness etc. These wireless mesh networks consists of: mesh clients, mesh routers and gateways (Fig. 1). The mesh clients are often laptops, cell phones and other wireless devices while the mesh routers forward traffic to and from the gateways which may but need not connect to the Internet.

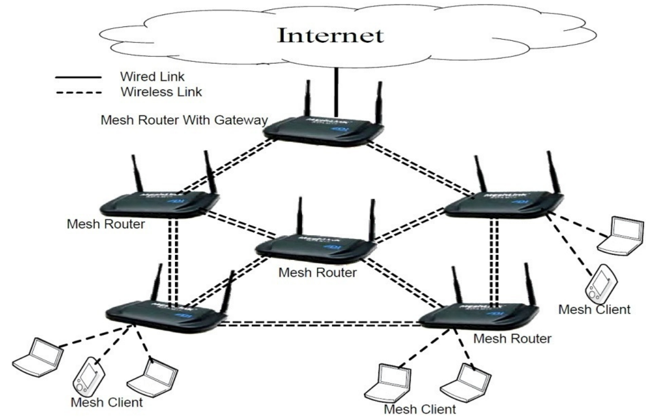


Fig. 1 Wireless Mesh Network

A wireless mesh network is a communication network made up of radio nodes organized in a mesh topology. These network are reliable and offers redundancy. When one node can no longer operate, the rest of the nodes can still communicate with each other, directly or through one or more intermediate nodes. WMNs are a promising next generation wireless networking technology. They intend to deliver wireless services to a large variety of applications in personal, local, campus, and metropolitan areas, such as public safety, environment monitoring, and citywide wireless Internet services. They have also been evolving in various forms e.g., using multi radio/channel systems to meet the increasing capacity demands.

However due to some interference from other collocated channel and fluctuating link conditions, WMNs may show frequent link failures. This affects its performance. For example, some links of a WMN may experience significant channel interference from other coexisting wireless networks. Some parts of networks might not be able to meet increasing bandwidth demands from new mobile users and applications. Links in a certain area (e.g., a hospital or police station) might not be able to use some frequency channels because of spectrum regulation. So a real-time recovery from link failures requires expensive manual network management.

## 2. Related Works

Many existing solutions for WMNs to recover from link failures are there. But each one has its own limitations. First, existing network configuration algorithms provide (theoretical) guidelines for network planning . However they may require global network configuration for every local link failure, thus incurring a very high management overhead or network disruption. Next, a greedy channel assignment algorithm can reduce the requirement of network changes for failure recovery, but one local greedy reconfiguration could cause QoS degradation or another failures at neighbouring nodes (i.e., ripple effect). Finally, fault-tolerant routing protocols, such as local re-routing or multipath routing , can be adopted to avoid those side effects. However, their reliance on detour paths or redundant transmissions can require more network resources than network reconfiguration[7].

## 3. Autonomous Reconfiguration System

To overcome the above limitations, an autonomous network reconfiguration system (ARS) is proposed [9] for static adhoc networks. A novel ARS allows a WMN to autonomously reconfigure its local network settings for real-time recovery from wireless link failures. The approach allows ARS to minimize changes of healthy network settings, while allowing for local changes around the failure location.

### 3.1 Flowchart

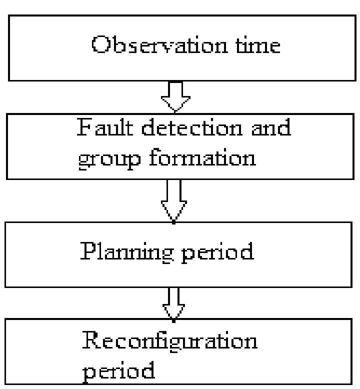


Fig. 2 Flowchart of ARS

The above flow chart describe the operation of autonomously reconfigurable system, first it at every time i.e. at 10 s observe the quality of wireless link and via management message, send result to gateway, after detecting the link failure trigger the formation of group, one of the group member selected as leader. The planning request is sent by leader node to gateway, then gateway generate reconfiguration plan for request, if there are multiple request. Reconfiguration plan send to the group member and leader node by gateway. All nodes in group execute the changes. Routing protocols send all the messages during formation and reconfiguration.

### 3.2 Modules

1. Link-Failure Detection: ARS in every mesh node monitors the quality of its outgoing wireless links at every time and reports the results to a gateway via a management message. Second, once it detects a link failure(s), ARS in the detector node(s) triggers the formation of a group among local mesh routers that use a faulty channel, and one of the group members is elected as a leader.

2. Leader Node: The leader node sends a planning-request message to a gateway. If any link is failure group members send request to the particular leader after that the leader node send request to the gateway.

3. Network Planner: It generates reconfiguration plans only in a gateway node. Network planner plans the diversity path for avoiding the faulty links. Then, the gateway synchronizes the planning requests—if there are multiples requests—and generates a reconfiguration plan for the request. Fourth, the 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.

## 4. Simulation Results

The test bed consist of several mesh node and in between there are IEEE 802.11b based wireless links. In order to receive and send strong signal from and to adjacent nodes, each node is placed on high level rate and transmission. For routing protocols weighted cumulative expected transmission time (WCETT) routing matrices are implemented [1]. The WCETT include assigning weight to every link given time in transmission linked out. WCETT has a routing metrics that take two things into account 1) Channel assignment diversity 2) Difference in the bandwidth of link. It has advantage to configure the best path for the variety of channel offered and bandwidth of link.

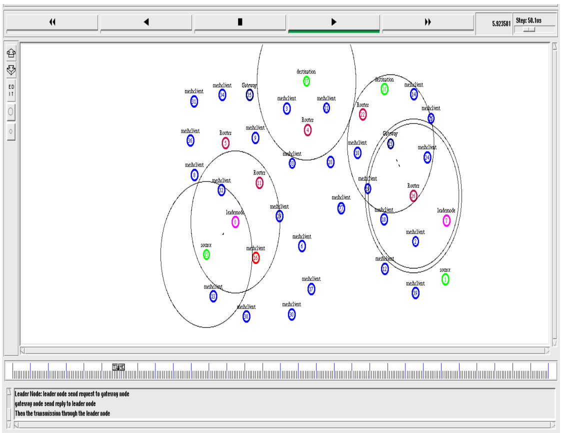

Fig. 3 NAM Window of Modified ARS

NAM window shows animation of how data transfer from source to destination .Total 40 nodes are generated, node 1 and 15 are the source nodes and, node 28 and 37 are the destination nodes. While transferring the data from source node to destination node, it select shortest path, but if in case link or node failure occurs then radio switch and channel switch done by ARS, another alternative shortest path is selected. As shown in NAM window node 16 is failed, so that data reach to the destination by choosing another path which comes in broadcasting range node in network. Meanwhile ARS detect failure in the network, reconfigure it and recover it. After reconfiguration again the first shortest path is selected. By doing this it helps to reduce loss of packets transfer, enhance channel efficiency and throughput. In existing and proposed method the nodes are immobile but in enhancement nodes are free to move anywhere and communicate with other nodes which are in broadcasting range ie, dynamic ADHOC network is implemented.

The different performance parameters, packet delivery ratio, latency and throughput are analysed for greedy channel , ARS and Modified ARS.

- *Packet Delivery Ratio (PDR):* Packet delivery ratio is defined as the ratio of data packets received by the destinations to those generated by the sources. Mathematically, it can be defined as: PDR= S1÷ S2 Where, S1 is the sum of data packets received by the each destination and S2 is the sum of data packets generated by the each source.

The comparison of PDR for greedy channel routing , ARS and Modified ARS are measured and outputs are shown using X -graph in Fig. 4.

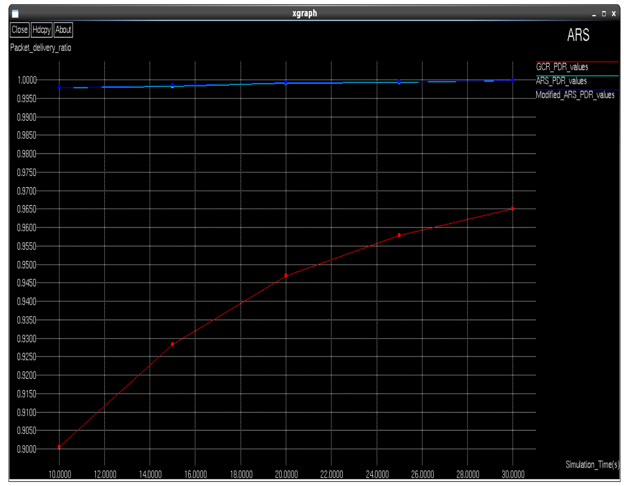


Fig. 4 Comparison graph of PDR vs Simulation Time

The above graph shows that the packet delivery ratio of Modified ARS and ARS is almost the same but better than the greedy channel routing algorithm.

- *Latency*: Network latency is an expression of how much time it takes for a packet of data to get from one designated point to another.
  From Fig. 5, it shows that Modified ARS has got the minimum latency when compared to the other methods.

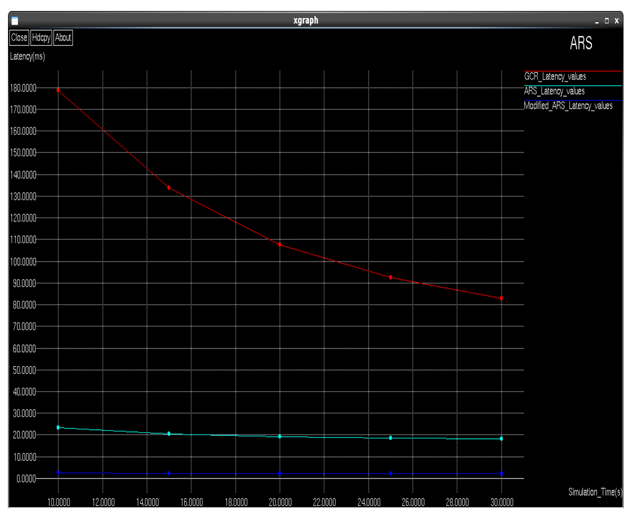


Fig. 5 Comparison graph of Latency vs Simulation Time

- *Throughput*: Throughput is defined as the total number of packets delivered over the total simulation time. Network throughput is the rate of successful message delivery over a communication channel.

Modified ARS causes improvement in the throughput of the network.

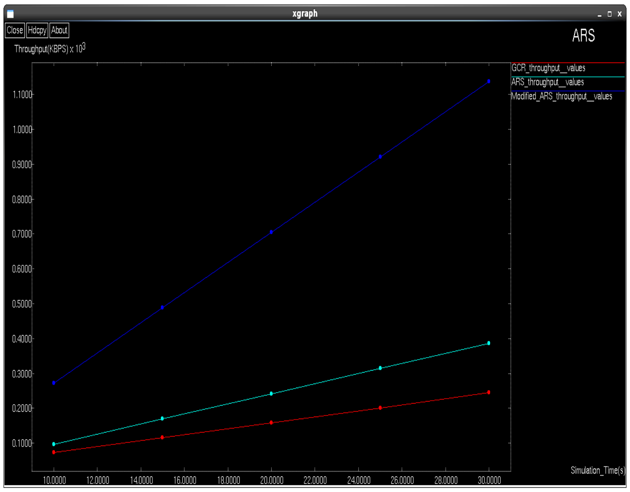


Fig. 6 Comparison graph of Throughput vs Simulation Time

## 5. Conclusions

We have implemented a Modified ARS for a mobile node configuration, based on IEEE 802.11b wireless links. It is found that a Modified ARS is more effective than ARS in terms of throughput and latency. By the election of leader node, the energy consumption and timing has been reduced. Thus a Modified ARS offers better efficiency in a mobile node configuration.

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