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Autonomously Reconfiguring Failures in Wireless Mesh Networks

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Abstract— Wireless mesh networks (WMNs) are being developed actively and deployed widely for a variety of applications They have also been evolving in various forms to meet the increasing capacity demands. However during their lifetime, multi hop wireless mesh networks (WMNs) experience frequent link failures caused by channel interference, dynamic obstacles, and/or applications' bandwidth demands. These failures cause severe performance degradation in WMNs or require expensive manual network management for their real-time recovery. This paper presents an autonomous network reconfiguration system (ARS) that enables a multi radio WMN to autonomously recover from local link failures to preserve network performance. By using channel and radio diversities in WMNs, ARS generates necessary changes in local radio and channel assignments in order to recover from failures. In addition, to strengthen its performance, this paper concentrates on avoiding the failures by setting up a threshold limit, which would eventually enhance the performance.

Keywords – *multiradio wireless mesh networks (mr-WMNs), self-reconfigurable networks, wireless link failures.*

I. INTRODUCTION

Due to heterogeneous and fluctuating wireless link conditions, preserving the required performance of such WMNs is still a challenging problem. For example, some links of a WMN may experience significant channel interference from other co-existing 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 etiquette or regulation. Even though many solutions for WMNs to recover from wireless link failures have been proposed, they still have several limitations as follows. First, resource-allocation algorithms can provide (theoretical) guidelines for initial network resource planning. However, even though their approach provides a comprehensive and optimal network configuration plan, they often require "global" configuration changes, which are undesirable in case of frequent local link failures. Next, a greedy channel-assignment algorithm can reduce the requirement of network changes by changing settings of only the faulty link(s). However, this greedy change might not be able to realize full improvements, which can only be achieved by considering configurations of neighboring mesh routers in addition to the faulty link(s). Third, fault tolerant routing protocols, such as local re-routing or multi- path routing, can be adopted to use network level path diversity for avoiding the faulty links.
However, they rely on detour paths or redundant transmissions, which may require more network resources than link-level network reconfiguration. To overcome the above limitations, we propose an Autonomous network Reconfiguration System (ARS) that allows

a multi-radio WMN to autonomously reconfigure its local network settings channel, radio, and route assignment—for real-time recovery from link failures.

II. RELATED WORK

A considerable amount of work has been done on the incentive compatibility problems in wireless mesh network. Network reconfiguration needs a planning algorithm that keeps necessary network changes (to recover from link failures) as local as possible, as opposed to changing the entire network settings. Existing channel assignment and scheduling algorithms provide holistic guidelines such as throughput bounds and schedulability for channel assignment during a network deployment stage. However, the algorithms do not consider the degree of configuration changes from previous network settings, and hence they often require global network changes. Reconfiguration has to satisfy QoS constraints on each link as much as possible. First, given each link's bandwidth constraints, existing channel-assignment and scheduling algorithms can provide approximately optimal network configurations. However, as pointed out earlier, these algorithms may require global network configuration changes from changing local QoS demands, thus causing network disruptions. We need instead a reconfiguration algorithm that incurs only local changes while maximizing the chance of meeting the QoS demands. Network reconfiguration has to jointly consider network settings across multiple layers. In the network layer, fault-tolerant routing protocols, such as local re-routing or multi-path routing, allow for flow reconfiguration to meet the QoS constraints by exploiting path diversity. However, they consume more network resources than link reconfiguration, because of their reliance on detour paths or redundant transmissions. On the other hand, channel and link assignments across the network and link layers can avoid the overhead of detouring, but they have to take interference into account to avoid additional QoS failures of neighboring nodes. Thus ARS is a suitable solution to deduce these problems.

III. PROBLEM STATEMENT

This paper presents an ARS system, which plays a major role in recovering failures in wireless mesh networks

1. Network construction

We create a network topology to send the data. Network has the node details. It maintains the connection details also. Nodes are interconnected and exchange data directly with each other nodes. Nodes are connected with other nodes in the network. Network server maintains the node ip address, port details and status. Node gives request to server and get the node details from server. A network is assumed to consist of mesh nodes and one control gateway. Each mesh node is equipped with radios, and each radio's channel and link assignments are initially made by using global channel/link assignment algorithms. Multiple orthogonal channels are assumed available. The interference among multiple radios in one node is assumed to be negligible via physical separation among antennas or by using shields. The gateway is connected to the Internet via wire-line links as well as to other mesh routers via wireless links.

2. Route Discovery

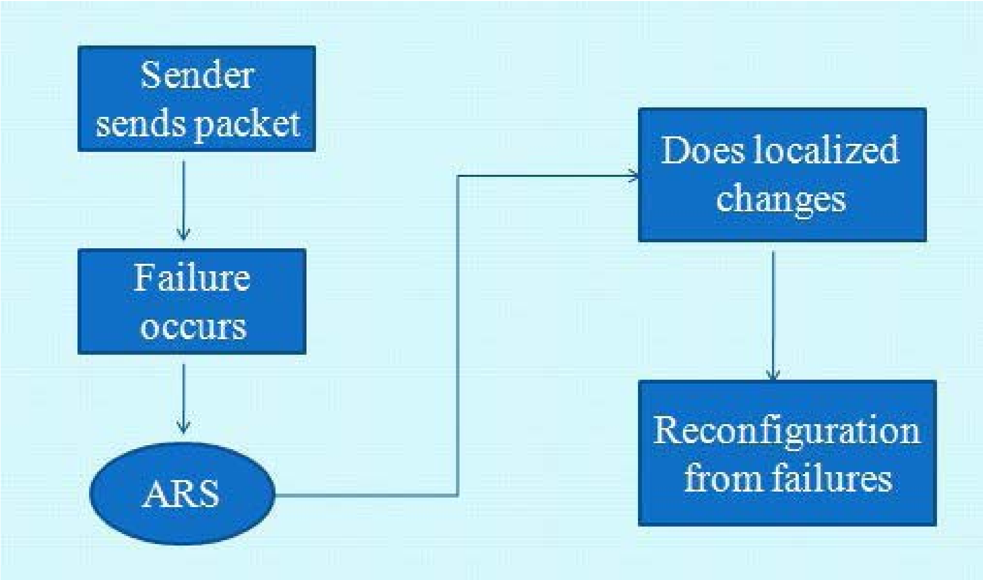
Send sender node request to receiver node a through all possible paths when connection established, and receive the response from receiver. We measure the available routes by getting details from server system. Calculate the path cost value for each available route. We measure the delay time for each available route from source node to destination node. It measures the throughput for each available route from source node to destination node.

3. Path Estimation

We calculate the minimum delay from source node to destination node. We calculate the sort path cost values. Among the path cost find out the minimum path cost Paths are available means process started to send data from sender node to destination node. Among that available path determine the shortest path, minimum delay time and throughput. We send
the data to receive node among these path.

4. Failure Discovery

Before sending the data, sender node will calculate threshold limit, because it is used to avoid the node failure of the sending data. While sending the data in that shortest path, It checks for the threshold limit. If the threshold limit exceeds, it alternatively measures the backup path with the constraint that the selected path does not have repeated nodes which was available in the previous path. Through this available path, the data from source node to destination node is sent.



5. Autonomous Network Reconfiguration System

ARS in every mesh node monitors the quality of its outgoing wireless links at every monitoring period. 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 using the well-known bully algorithm for coordinating the reconfiguration. Third, the leader node sends a planning-request message to a gateway. Then, the gateway synchronizes the planning requests, if there are multiple 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. We assume that during the formation and reconfiguration, all messages are reliably delivered via a routing protocol and per-hop retransmission timer.

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