

# Link Failure Detection in Wireless Mesh Network: Survey

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**ABSTRACT:** A wireless mesh networks is one of the most advanced wireless network is used for the wireless communication. Recent application of the WMNs is used to construct smart cities to provide broadband internet services to the users. WMNs implemented by IEEE 802.11, 802.15, 802.16 etc. Because of the mesh topology WMNs may suffers from the frequent link failure which degrades the network performance. To overcome of this problem, various link failure detection technique is used. The proposed survey paper presents the review of the various detection technique used to recover the link failure in WMNs.

**KEYWORDS:** WMNs; self-configuration; ARS; ETX.

## I. INTRODUCTION

WMNs is recently emerged network having robustness. It is made up with the radio nodes are connected with the mesh topology. WMNs consists the mesh router, mesh clients and gateway. Mesh clients consists of the laptops, cell-phones and other devices. WMNs are dynamically self –organized and self-configured and also automatically established an ad-hoc network. WMNs are implemented by IEEE 802.11, 802.15 etc.

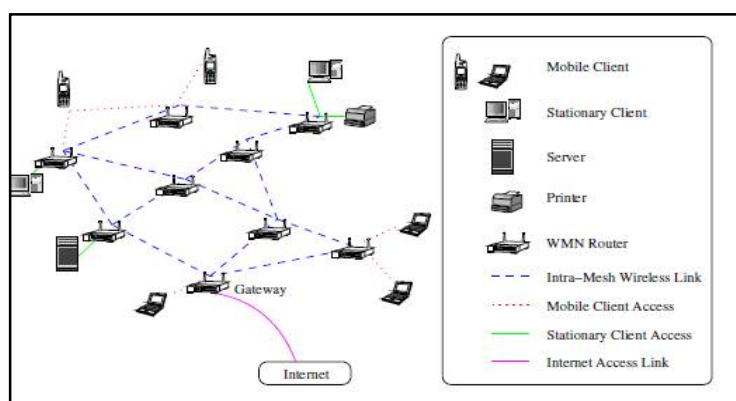


Fig. 1. A WMN interconnecting stationary and mobile Clients[1]

The infrastructure of wireless mesh network shown in fig.1[1]. This infrastructure built using various types of the radio nodes. The mesh router as shown in the fig. having the additional features of self-healing and also they are automatically connected with the mesh topology. Mesh router are act as the access points and plays a very important role in mesh connectivity and it supports the mesh network. Mesh clients is similar to the conventional client but it is mobile. It additionally includes routing capabilities to support mesh network. Thus a mesh client works as a router and broadens the coverage. In the contrary of mesh router, it includes only 1 network interface card. It doesn't include gateway or bridge or repeater functions for the support of communication with different network. It has vast varieties of hardware platform. They are self-configured, self-healed.

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Self-reconfiguration : It means in simple words is self healing to any condition.

The below system shows the Broadcasting media and the client accessing it through wireless Mesh network. Packet is transferred from one end to other end and if there is packet failure then packet is reconnected through different path and packet is delivered to the destination. Therefore need of self-reconfiguration is very important in the means of packet sending from source to destination.

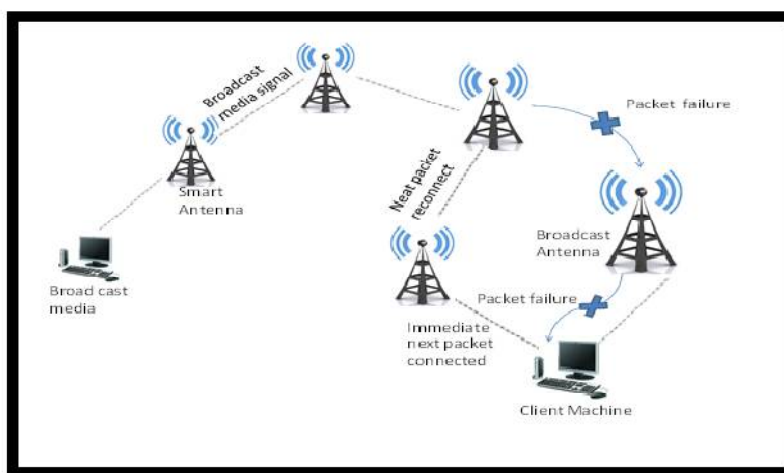


Fig. 2 Need of self-reconfiguration[5]

Interference is the major bottleneck in wireless mesh networking. It is the term that has been used to refer to a number of different things. The adopted some definitions and types of interferences are as follows[2] :

### A. Radio interference

Radio interference represents the physical interference that can influence the electromagnetic waves in wireless communication. It represents a superposition of signal or wave which changes the original signal and causes bit alteration which in turn cause data or frame check sequences alteration. The result of this alteration is that the link layer may drop the packets resulting in the failed transmission.

### B. Channel contention interference

Channel Contention Interference stems from the medium access protocol which obliges the station to wait until the channel is free to commence its transmission. Channel Contention Interference primarily refers to the deferred access to medium caused by the protocol (CSMA-CA based MAC) because the shared channel may be occupied by transmission from other nodes that are using the same channel within the Carrier Sensing range of the node and this represents "interference". Channel Contention Interference has been referred to as Interference at the MAC layer and in some applications this interference referred as to Traffic Interference. Channel Contention Interference therefore refers to a "logical" interference as it is part of the interference which occurs before transmission. Sometimes it is known as the Logical interference, also.

### C. Intraflow interference

Intraflow Interference refers to interference within a flow traversing multiple wireless hops. Successive links in the path of a flow can interfere with each other and impact performance.

### D. Interflow interference

Inter-flow Interference refers to interference between flows sharing the same channel and competing for medium access.



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## II. RELATED WORK

### A. Link recovery techniques

Because of the mesh topology the link failure is crucial problem in the WMNs. And because of the link fails the network performance be degrades largely. There are various technique used for link recovery [6] and some of this are listed below :

#### a. Initial resource allocation methods

As per the name suggests the initial planning is done for resources of the network. This method has a drawback of the 'Global Reconfiguration Change'. This technique is not feasible for the frequent link failure. To overcome of this problem, the authors Bhati, li & alcherry [7] suggests the new method named ' Joint Channel Assignment'. By using this method the channel assignment problem has been handled. For this method the physical, inter\intra interference has been considered.

#### b. Greedy channel assignment method

The problem which faced in 'Initial Resource Allocation Method' has been overcome by this method[8]. In this method only the faulty link has been changed. The whole network be same as before. So, this method may suffers from the 'Ripple Effect'.

#### c. Autonomous reconfigurable system(ARS)

The authors Kim and Shin [9] has proposed Autonomous Reconfigurable System has additional reconfigurability by considering the range of the channel. ARS is not cost aware reconfiguration technique, it is the main drawback of ARS.

### B. Requirement of self-configurability

Link failure is the major problem for the WMNs. It degrades the performance largely. To overcome the link failure the hand operated system management is been also preferred. But this system is very much expensive process and also very difficult for dynamic link failure. So, the reconfigurability is required for good network performance.

#### a. Good for low quality links

The interference which occurs from the near by network which degrades the performance of the network. For this problem the channel switching technique is used. In the channel switching technique the faulty link switch to the interference free channel and by doing that can control the link failure.

#### b. Requirement of good QoS

It is very difficult to achieve good\satisfied QoS. In the conference room the good QoS required. In this concept, link has to deliver at very high data rate in short period of time with better QoS. For this Radio Switch mechanism being preferred. In the radio switch mechanism the radio nodes which having the heavily loaded radios are reassociated with the less loaded radio nodes.

## III. DETECTION MECHANISM FOR LINK FAILURE

Detection of link failure in WMN is an important issue in working of WMN. There are various techniques used for detection of link failure such as cross layer model which perform timely detection of failed link.

### A. Link failure detection using neighbor discovery mechanism

In Neighbor Discovery Mechanism the concept of HELLO message is used. In this, all the nodes of network send HELLO message to all other neighbored nodes in it's communication range. After receiving number of HELLO message on the link, the link is assumed to be in good condition & can be used for routing of packets. In the absence of HELLO messages on link for specific time interval, it is assumed that the link failure has occurred. Real Time application can be not use this approach for link failure detection because large amount of delay occurs in this approach.



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## B. Link failure detection using cross layer approach

In Cross layer Approach, whenever a MAC frame is received then the acknowledgement is sent for that frame. If the acknowledgement is not received then that frame is retransmitted. The number of times frame retransmission is performed & after that the delivery is assumed to be failed and frame is lost. Detection of link failure is performed by taking into account the number of failed delivery occurred in MAC layer along with the information about transmission errors. The advantage of cross layer approach over simple approach of neighbor discovery is the fast finding of link failure.

To ensure the correctness of link failure detection types of transmission error must be identified correctly. Basically there're two types of transmission errors transient error and permanent error. Transient error can be removed by performing the retransmission of frames in MAC layer while the permanent errors have to handle differently. If the link is permanently failed then this type of failure is handled at routing layer by choosing alternate path for routing of packets during communication. The type of error must be detected correctly otherwise false alert occurs. False alert means the transient errors are misunderstood as permanent error. Because of this, the additional overhead of re-routing of packets is occurred. For better performance of wireless mesh network the false alert must be avoided.

## IV. METRIC COMPONENTS

In this section, we identify and discuss the key components that can be utilized to compose a routing metric for multi-channel wireless mesh networks.

### A. Number of hops

Hop count can serve as a routing metric in itself, such as in most WMNs routing protocols. Hop count as a routing metric for wireless mesh networks has significant limitations. It has been shown in [9] that a path with a higher number of high-quality links demonstrates significant performance improvements over a shorter path comprised of low-quality links and additionally, the authors also found that hop count tends to route through a few centrally-located nodes, leading to congestion and hot spots.

### B. Link quality

Finding high-quality links will highly improve the overall network performance of a path through higher transfer speeds and lower error rates. Link quality can be measured in a number of ways. The most common metric is Packet Loss Rate (PLR). Network routing Quality is nothing but the minimum packet loss data delivery. To know data delivery changes over time scale considered by total no. of packets are lose in the network. It is measured by packet delivery ratio; each node took a turn sending a series of broadcast packets up to some seconds, and counted the number of packets that reported as transmitted [9]. Packets contained fixed size of data payload. It is calculated by,

$$PDR = \frac{\text{Send\_packets} - \text{Drop\_packets}}{\text{Send\_packets}} \quad \text{eq. (1)}$$

### C. Expected transmission count (ETX)

Expected Transmission Count (ETX) [2] is a measure of link and path quality. It considers the number of times unicast packets need to be transmitted and retransmitted at the MAC layer to successfully traverse a link. The ETX path metric is simply the sum of the ETX values of the individual links. ETX considers the number of transmission in both directions of a link, since the successful transmission of a unicast packets requires the transmission of the packet in one direction plus the successfully transmission of an acknowledgement in the reverse direction. ETX is mostly determined by means of active probing, in which the number of successfully received packets is compared with the number of packets sent in a given time window. Here ETX tends to select links on path with lower rate so that it is the time for a packet to reach its destination. The scalability of a routing protocol is critical if end-to-end delay can become large. Furthermore, even when the path is established, the node states on the path may change. Setting up a routing path in a very large wireless network may take a long time. Delay is to travel a path from its source to its destination. Finally we were considered the total number of delayed packets for its calculation,

$$DELAY = \frac{\text{Total Delayed\_packets}}{\text{Total Recevied\_packets}} \quad \text{eq. (2)}$$



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## V. CONCLUSION

This paper gives the mechanism of different methods for detection of link failure in wireless mesh networks and also presents the survey of various link recovery technique for WMNs, and also discuss the metric components that can be utilized to compose a routing metric for multi-channel wireless mesh networks.

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