

Survey of Router Link Failure Detection in Wireless Mesh Network

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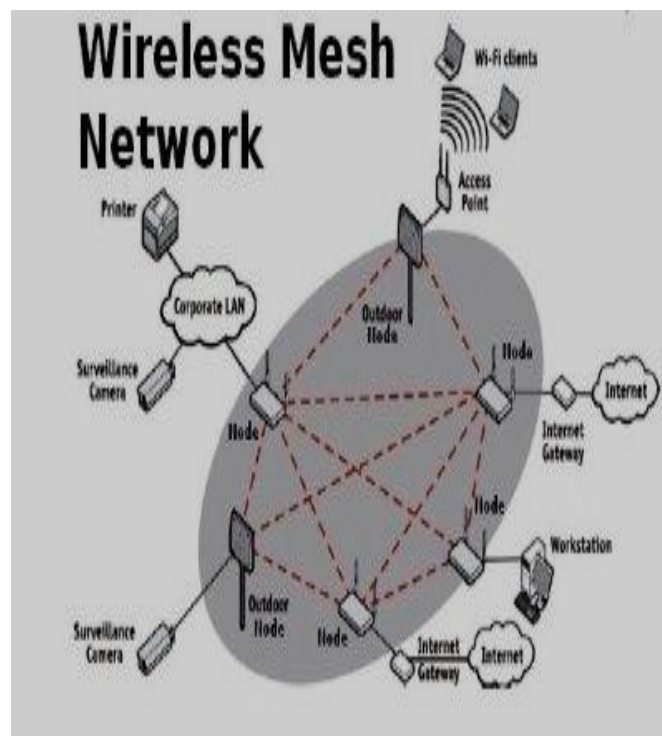
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Abstract: Routers are small electronic devices that join multiple computer networks together via either wired or wireless connections. A tree topology is used to construct a wireless sensor network for data delivery applications. Data delivery failures occur in the form of mobile node movements and topology changes. To increase the data delivery ratio and mitigate the effects of packet loss caused by the mobile nodes. A wireless mesh networks is one of the most advanced wireless network, used for the wireless communication. Wireless network may suffer from frequent link failure which degrades the network performance. The proposed survey paper presents the review of the various detection techniques used to recover the router link failure in Wireless Mesh Network.

Keywords: mesh topology, Link Failure detection, multipath routing, recovery techniques, router firmware, HELLO message.

I. INTRODUCTION

A wireless mesh network (WMN) is a communications network made up of radio nodes organized in mesh topology. It is also a form of wireless ad hoc network. A mesh refers to rich interconnection among devices or nodes. Wireless mesh networks often consist of mesh clients, mesh routers and gateways. Mobility of nodes is less frequent. In technical terms, a router is a Layer 3 network gateway device, meaning that it connects two or more networks and that the router operates at the network layer of the OSI model. Routers contain a processor (CPU), several kinds of digital memory and input-output (I/O) interfaces. They function as special-purpose computers, one that does not require a keyboard or display. The router's memory stores an embedded operating system (O/S). Compared to general-purpose OS products like Microsoft Windows or Apple Mac OS, router operating systems limit what kind of applications can run on them and also need much smaller amounts of storage space.





These operating systems are manufactured into a binary firmware image and are commonly called router firmware. To detect link failure or recovery, nodes regularly send small messages called probes on all the links on which they send traffic, and listen for probes on the links from which they receive traffic.

Wireless Mesh Network (WMN) is one of the latest wireless communication technologies. Wireless Mesh Network uses multiple radio & multiple channel architecture while previous wireless networks use single radio, single frequency architecture. By making use of multiple radio & multiple channel architecture, WMN removes most of the problems associated with single radio & single channel architecture in conventional system. The main feature of Wireless Mesh Network is the ability of network to sustain the performance in the presence of large number of errors. In wired network a small amount of error can stop the working of entire network. But in WMN the single node is connected to multiple nodes, due to which the alternate path are always available in case of failure. The advantage of WMN is its expandability. The new nodes can be added easily in network. There are two types of Wireless Mesh Network Indoor Wireless Mesh Network and Outdoor Wireless Mesh Network.

II. DETECTION MECHANISM FOR ROUTER LINK FAILURE

A. Detecting Link Failure by using Neighbor Discovery Technique

This Mechanism uses the concept of HELLO message. HELLO messages are sent by all the nodes of network to all other neighbored nodes in its communication range. When the link receives number of HELLO messages, it is considered to be in good state and can be used for routing of packets. If there is absence of HELLO messages on link for specified time duration, it is considered that the link failure has occurred. Due to longer delay, this approach is not suitable for link failure detection in case of Real Time applications.

B. Detecting Link Failure by using Cross Layer Mechanism

In this Approach, the acknowledgement is sent for every frame received by MAC. The frame gets retransmitted if the acknowledgement is not received. Retransmission of the frame is repeated for specific number of times and after that the delivery is considered to be failed and frame is lost. Detection of link failure is performed on the basis of number of failed delivery occurred in MAC layer along with the information about transmission errors. When compared to neighbor discovery mechanism, the cross layer approach is advantageous. The correctness of Link Failure detection is dependent on the correct identification of transmission errors. Mainly there are two types of transmission errors namely, transient error and permanent error. Transient error can be abolished by retransmitting the frames in MAC layer. Where as permanent errors have to be handled differently. The permanent link failure can be handled at routing layer by selecting alternate path for routing of packets during communication. It is very essential to detect the type of error correctly otherwise false alert occurs. The meaning of false alert is that the transient errors are misunderstood as permanent error. Due to such errors, the additional overhead of re-routing of packets may arise. To avail the better performance of wireless mesh network the false alert must be controlled and avoided.

III. TECHNIQUES FOR LINK RECOVERY IN WIRELESS MESH NETWORK (WMN)

Link Recovery plays very important role in Wireless Mesh Network. The performance of Wireless Mesh Network degrades largely if there is link failure. There are various techniques used for Link Recovery in Wireless Mesh Network. Some of them are listed below.

A. Initial Resource Allocation Method

In this type of algorithm, the initial planning is done for resources of the network. They use some theoretical guidelines for allocation of resources. This technique has drawback of "Global reconfiguration Changes". For small changes done for link recovery, this technique performs reconfiguration of the entire network which is not feasible in case of frequent link failure. The authors Bhati, Li & Alcherry suggested the new method namely "Joint Channel Assignment Method". For handling the channel assignment and routing problem this method make use of concepts in mathematics. The various issues like interference and channel availability are being considered in this method.

B. Greedy Channel assignment Method

This method removes the main drawback of "Initial Resource Allocation Method" reconfiguration which occurs globally. In this method, the setting of only faulty link is changed rather to change entire network. The drawback of this method is "ripple effect". In this kind of effect whenever one local change occurs then it causes triggering of change to some other kind of network settings.

C. Fault Tolerant Routing Protocol

Routing protocols plays very important role in case of recovery of link failure.



Whenever the link failure occurs, then to overcome that link failure we can route the packet via different link. For this some fault tolerant routing protocols like local rerouting or multipath routing can be used.

D. Autonomous Reconfiguration System (ARS)

A new recovery technique for wireless mesh network named ARS proposed by Kim and Shin. This technique improves the performance of wireless mesh network largely as compared to other types of link recovery techniques. ARS generates set of reconfiguration plans by considering the range of channel & radios of network. The feasible plan is chosen out of the set of this reconfiguration plan which maximizes the network throughput & also satisfy some QoS constraint of network. The main drawback of ARS is that it is not cost aware reconfiguration technique.

IV. NEED FOR SELF RECONFIGURABILITY

The link in WMN plays very important role in working of WMN. Because of link failure, the wireless mesh network is not able to perform better. The hand-operated network management system can be used to perform link recovery. But it is very much expensive process & also very difficult to implement in case of dynamic link failure. Some of the examples in which the self- reconfigurability is necessary are given as follows

Recovering From Low Quality Link

In WMN the links between nodes of network may suffer interference from nearby wireless network in particular region. To solve this problem, the concept of channel switch is used. In channel switch the tuned channel of link is switched to other interference free channel. In this way local link can be recovered from link failure.

Satisfying QoS Requirement

The scenario where such QoS requirement occurs is the links around conference room. This link has to deliver large amount of data in short period of time. In order to provide such QoS requirement of end user the concept of radio switch is used. In this concept the heavily loaded radios are re associated with less loaded radios.

Priority Use of Channel

Spectrum regulation plays an important role in working of WMNs. The predefined rules for use of spectrum may not allow some links to use certain channel in given area. Such Channels are used for handling emergency condition

V. MULTIPATH ROUTING IN WMN

The concept of multipath routing is important in Wireless Mesh Network. The performance of Wireless mesh network is improved significantly by using concept of multipath routing. The main objective of multipath routing is to provide fault tolerance to the network and to reduce the routing overhead. Reliability of network and load balancing of network can also be increased largely by using multipath routing. The main issue in multipath routing are the gathering of large number of control messages during routing and congestion occurring in gateway.

Flooding of Control Messages during Routing

Routing of the connection is established with the help of Route Request message. All the intermediate node respond to this message. All such control messages are then passed to the gateway in large amount. This results in performance degradation of entire network.

Congestion Occurring at Gateway

The gateway has to relay data packets as well as control packets. When congestion of control packets occurs at gateway then most of its time are wasted in processing of control packets. Due to this the performance of network degrades severely. In K.Valarmathi and N. Malmurugan suggested new multipath routing protocol for WMN. In this protocol initially they determine interference of each link and calculate the load carried out by each link of the network. By considering this two parameter, the combined routing metric is determined. The next step is to determine multiple shortest path in the network.

From the number of the shortest path, the path which has minimum value of combined metric is chosen as main path for routing. If any kind of failure occurs in main path then the transmission of packets is performed via backup path. K.Valarmathi and N. Malmurugan uses NS2 (Network Simulator 2) to simulate the Multipath Routing for Improving reliability (MRIR) Protocol. They compare MRIR protocol with Multi-Path Parallel Routing Protocol (MPRP). The performance evaluation is done by considering parameters like Average End-To-End delay, Average Packet Delivery Ratio & Overhead. This protocol shows greater performance as compared to other existing multipath routing protocol for Wireless mesh Network

CONCLUSION

As the need of wireless mesh network is increasing rapidly, detection and recovery of link failures and has become one of the most significant issues. This paper discuss the methods Neighbor Discovery Mechanism & Cross layer Approach for detection of Link Failure in WMN. The paper presents the survey of various link recovery techniques like Initial Resource Allocation Method, and Greedy Channel Assignment method in detail. It finally discuss the use of Multipath routing for recovery of Wireless Mesh Network.

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