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Auto-Healing Of Wireless Mesh Network

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***Abstract--* In this paper, we tend to describe the advance in auto-healing technique in wireless mesh network. A wireless mesh network has got to face issues like dynamic obstacles; Bandwidth demands channel interference, etc. this sort of failures causes performance degradation in wireless mesh network. The Autonomous reconfiguration system given over this paper helps a Multiradio WMN to recover from link failure in an autonomous approach. ARS checks and makes the mandatory changes within the network. Based on the changes generated the network is reconfigured. We tend to use AODV routing protocol for routing**.

I. INTRODUCTION

Wireless Mesh Networks:

WMN may be a network that's created through the association of wireless access points that installed at each node. It consists of mesh clients, mesh routers and gateways.Fig.1 shows paradigm of Wireless mesh network. Nowadays WMNs are used widely and are hastily undergoing progress [2]. Although WMNs are widely used they face problem due to frequent link failures. To beat these failures several solutions are anticipated like resource allocation algorithm,, greedy channel assignment algorithm, and fault tolerant routing protocols [1].

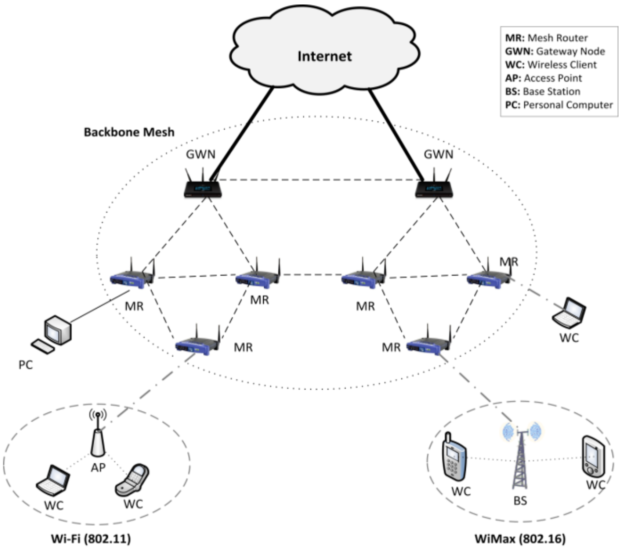

Fig.1. Wireless Mesh Network

Resource allocation algorithm:

Allocates the resources at the start. The drawback is even though they provide an optimal solution they require the global configuration changes, which is not suitable in case where frequent link failures occur [14] [16].

Greedy Channel- Assignment:

Changes the setting of just faulty links. But problem is we need to know configuration of all neighbor nodes in mesh along with the faulty link(s)[17].

Fault- tolerant routing protocol:

Can be used to keep away from the faulty links. The examples is local rerouting, multipath routing. They depend on redundant transmission, which needs the more amounts of network resources than the reconfiguration in link-level network [18].

The autonomous reconfiguration system (ARS) overcomes above mentioned limitations. ARS enables Multiradio WMN to configure automatically its local network settings such as channel, radio and route alignment, so that it can recover from the link failures. In its heart, the ARS is reconfiguration planning algorithm that will recognize the configuration changed within local network for recovery, hence minimizing changes of healthy network. In alternative words, ARS will initially search for the local reconfiguration changes that are available around a faulty area. Then, accordingly will impose current network setting. ARS also comprise monitoring protocol that enables a WMN to perform real-time recovery from failures. It additionally prevents the ripple effects. The monitoring protocol runs in every mesh node and it periodically measures wireless link conditions. Depending on measurement information ARS determines the failure of link and generates the reconfiguration plan. The remaining paper is explained follows- section II – Need of self reconfiguration, section III- ARS architecture, section IV Methodology, section V-Conclusion of the paper.

II. MOTIVATION

A. Need of Self Reconfiguration:

The following examples illustrates why self-reconfiguration is important.

Recovering from Link- quality degradation:

The other collocated wireless networks can interfere and degrade the link quality of wireless links in WMNs [21] [19]. As an example, cordless phones, Bluetooth that operate on similar or adjacent channels causes important losses or collisions within the transmission of packets.

Satisfying dynamic Quality of Service demands:

Depending on spatial or temporal locality, the links in some areas might not be appropriate to accommodate the increasing quality of service demands from end users [20]. Consider the links within a conference room may have to relay a large amount of data/video traffic during the session. Similarly, the relay links present outside the conference may not be able to satisfy the requirement of all attendees. The communication failures between links can be avoided by reassigning their channels with the unutilized channels available nearby.

Copying with heterogeneous channel availability:

Links in some areas could also be unable to access the channels during a period of spectrum failures. If the channel is being for the emergency response then several links need to free the current channels.

B. Network Model:

Multi-radio WMN:

The network model is consisting of the mesh nodes, wireless links that are based on IEEE802.11, and a gateway that will act as a control gateway. Each node is n- radios. Each channel for radio and link assignments is made using global channel/link assignment algorithms initially [9], [16], [17]. It's assumed that the interference among the multiple radios of one node is negligible by using shields. The gateways are connected to the Internet via the wired links, and to the other routers via wireless links.

Link Failures:

We primarily focus on the channel-related link failures that are the results of narrowband channel failures. For long term failures that last for weeks or months the network-wide planning algorithms are suitable and for the short term failures that occur in order of milliseconds the dynamic resource allocation can be satisfactory. In this paper the hardware failures are not considered.

QoS Support:

Each operating mesh node will periodically send its local channel usage and the quality information to control nodes via the management messages for its entire outgoing links. After that gateway is based on data from mesh node will control the admission of requests for voice or video flows. Then the networks will run the routing protocols. The route discovery and recovery algorithms are included in this routing protocol, which can be used to maintain the alternative paths in presence of link failures.

III. ARS ARCHITECTURE

The fig.2 shows the architecture of ARS. ARS is provided with a hook so that it can capture and send the packets related to ARS similar to the group formation data. In addition, it also includes:

1] Network planner – that will generate the network reconfiguration plan in the gateway.
2] Group organizer – is responsible for the formation of local groups in mesh routers.
3] Failure detector – it interacts periodically with the network monitor that's in utility and also keeps up-to-date link status.
4] Routing table manager - manages the state of the routing table.

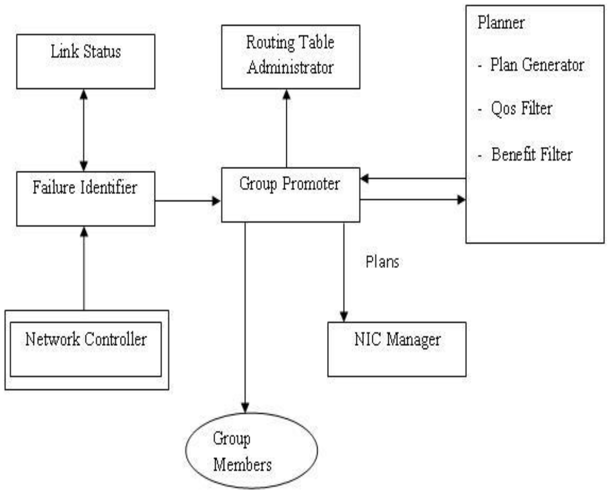

Fig.2. ARS Architecture

Planning For Reconfiguration of Network:

To generate localized reconfiguration planning is the basic function of the ARS.A reconfiguration plan is defined as a group of links configuration changes that are needed for a network to get over the link failure on a channel, and there are multiple reconfiguration plans existing for one link failure [1]. Initially the connection of network is going on so that a feasible reconfiguration plan that has the channel, link & route channels in case of link failure is generated.

1) *Feasible plan Generation:*

ARS will detect the essential changes in the local links so the link failure can be removed. ARS maintain the exiting connectivity of the network. The challenges to ARS in generating the feasible plan are-

- Avoid faulty channels.
- Maintaining network connecting and utilization.
- Controlling the reconfiguration changes.

2) QoS-Satisfiability Evaluation:

From the set of the feasible plans generated ARS has to choose the plan that satisfies the QoS constraint. Even though it is ensured all the plans generated will be avoiding faulty links, they will not satisfy the QoSconsraint.ARS needs to separate out such plans.

3) *Choosing Best Plan:*

ARS has plans that also give the QoS constraint, now ARS have to choose a path that may have uniformly distributed links capacity.

IV. METHODOLOGY

ARS runs in each mesh node and supports self re-configurability through following distinct features:-

Localized reconfiguration:

ARS generate reconfiguration plans that allow for changes of network configuration only in the neighborhood where link failures occurred.

QoS-aware planning:

QoS-satisfiable is done by ARS by following steps:-

1. Estimating generated reconfiguration plans is calculable for QoS –Satisfiability
2. Expected benefits are derived in channel utilization.

Using link-quality monitoring for autonomous reconfiguration:

Distributed manner ARS precisely monitors the quality of each node. ARS detects local link failure based on given links CSOS constraints and a few measurements and finally sorts networks reconfiguration.

Cross layer interaction:

There's interaction of ARS with networks and link layer for planning in link layer.

Algorithm:

1. Monitoring period (Mp)

1. for every link M does
2. calculate link quality (LQ) with the help of passive monitoring.
3. end for
4. send result to a gateway G of control.

2. Failure identifier and group organizing period (TP)

1. if link L is not satisfies link requirement R then
2. ask on channel H of link L of a group organizing
3. end if
4. if authorization is acceptable then start a leader election process

3. Planning time (M, TP)

1. if node E is a leader after election then
2. planning request message (H,M) to a gateway;
3. else if node is a gateway then
4. set Mn send again request for reconfiguration
5. for Mn generate a configuration plan (P)
6. leader of Mn collect the reconfiguration plan (P)
7. end if

4. Reconfiguration node (P, tr)

1. if P has changes of node E then
2. allot the changes to link at t
3. end if
4. relay P to adjacent node, if any

The above algorithm shows the operation of the autonomous reconfiguration system. There are four phases within the algorithm as described below:

1] *Monitoring Period:* This period checks the link quality by passively observing the nodes and the results are forwarded to the controlling gateway.

2] *Failure Identification:* Once the control gateway obtained results, then gateway checks for the link failure. Just in case of failures the group is formed and a leader is elected.

3] *Planning period:* Once electing a leader the reconfiguration plan is generated. There can be more than one plan for same link failure. The control gateway will select the feasible plan.

4] Reconfiguration node: In reconfiguration node no matter what changes are necessary for reconfiguration are made and the reconfiguration plan is relayed to the adjacent node.

V. Conclusions

This paper offered improvement of self-reconfiguration techniques in wireless mesh network. ARS system enables WMN to automatically change path of network locally. Using AODV routing protocol in ARS, throughput is increase up to 450% by static methodology. ARS also sense real time link failure and after that reconfigure network so channel efficiency also improved up to 92% compare to static methodology.

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