Enhanced Autonomous Reconfiguration for Wireless Mesh Networks

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***Abstract*— Link failures are one of major issue in the networking area. Wireless mesh networks are concerned these provides larger coverage and high data rate information transfer. Even though they provide lot of benefits to the users and several high range applications they still suffer from the occurrences of the link failure. These link failures will occur due to some interferences, different obstacles etc. This paper presents an autonomous network reconfiguration system (ARS) that enables a multiradio WMN to autonomously recover from local link failures to preserve network performance. By this link failure the information transfer can be lost so the quality of communication cannot be achieved and also the performance of this Wireless Mesh Networks can low. So in order to recover from the link failures Autonomous Reconfiguration System is used. This algorithm provides Autonomous reconfiguration to the links by employing group formation technique. Even though this algorithm provides the recovery for the link failure it provides limitations such as higher delay, low throughput etc. In order to overcome the limitations of Autonomous Reconfiguration System (ARS) algorithm, a modified version of Enhanced Autonomous Reconfiguration (E-ARS) have been developed. This algorithm provides a different approach. So that the delays are made low, throughput is made higher and also several other parameters are also analysed comparing to the ARS. These overall process are shown and simulated using the software called Network Simulator -2 (NS-2).**

***Keywords*— IEEE 802.11, multiradio wireless mesh networks (mr-WMNs), Routing, self-reconfigurable networks, wireless link failures*.

I. INTRODUCTION

Wireless mesh networks are boon to the wireless architecture. 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 adhoc networks for the easy of network maintenance, robustness etc.

Wireless mesh networks [6] often consist of mesh clients, mesh routers and gateways. 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.

The coverage area of the radio nodes working as a single network is sometimes called a mesh cloud. Access to this mesh cloud is dependent on the radio nodes working in harmony with each other to create a radio network. A mesh network is 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. A wireless mesh network can be seen as a special type of wireless ad-hoc network. A wireless mesh network often has a more planned configuration, and may be deployed to provide dynamic and cost effective connectivity over a certain geographic area.

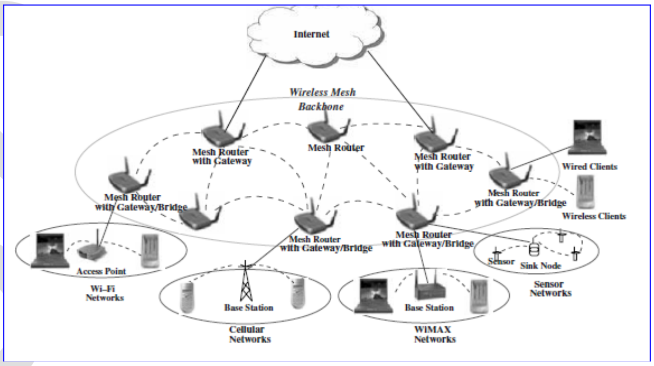

Fig.1 wireless mesh network

Wireless mesh networks (WMNs) are being developed actively and deployed widely for a variety of applications, such as public safety, environment monitoring, and citywide wireless Internet services.

They have also been evolving in various forms (e.g., using multiradio /channel systems to meet the increasing capacity demands by the above-mentioned and other emerging applications. However, 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 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 etiquette or regulation.

Wireless mesh networks does not provide centralized trusted architecture too, to distribute the public keys. Here in the wireless mesh network, mesh clients should contain power efficient protocols. Mesh routers in the wireless mesh networks perform dedicated routing and configurations.

II. RELATED WORK

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 neighbouring mesh routers in addition to the faulty link(s). Third, fault-tolerant routing protocols, such as local rerouting or multipath 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.

A. Channel Assignment Algorithm

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 to meet all the constraints. Even though these algorithms are suitable for static or periodic network planning, they may cause network service disruption, and thus are unsuitable for dynamic network reconfiguration that has to deal with frequent local link failures.

The greedy channel-assignment algorithm, which considers only local areas in channel assignments, might do better in reducing the scope of network changes than the channel assignment algorithms. However, this approach still suffers from the ripple effect, in which one local change triggers the change of additional network settings at neighboring nodes due to association dependency among neighboring radios. This undesired effect might be avoided by transforming a mesh topology into a tree topology, but this transformation reduces network connectivity as well as path diversity among mesh nodes.

Interference-aware channel assignment algorithms can minimize interference by assigning orthogonal channels as closely as possible geographically. While this approach can improve overall network capacity by using additional channels, the algorithm could further improve. These algorithms may require global network configuration changes from changing local QoS demands, thus causing network disruption.

B. Autonomous Network Reconfiguration System (ARS)

Autonomous network reconfiguration system (ARS) that allows a multiradio WMN (mr-WMN) to autonomously reconfigure its local network settings—channel, radio, and route assignment— for real-time recovery from link failures. In its core, ARS is equipped with a reconfiguration planning algorithm that identifies local configuration changes for the recovery while minimizing changes of healthy network settings.

Briefly, ARS first searches for feasible local configuration changes available around a faulty area, based on current channel and radio associations. Then, by imposing current network settings as constraints, ARS identifies reconfiguration plans that require the minimum number of changes for the healthy network settings.

Next, ARS also includes a monitoring protocol that enables a WMN to perform real-time failure recovery in conjunction with the planning algorithm. The accurate link-quality information from the monitoring protocol is used to identify network changes that satisfy applications’ new QoS demands or that avoid propagation of QoS failures to neighbouring links (or “ripple effects”). Running in every mesh node, the monitoring protocol periodically measures wireless link conditions via a hybrid link-quality measurement technique.

ARS has been implemented and evaluated extensively via experimentation on our multiradio WMN test-bed as well as via ns2-based simulation. ARS outperforms existing failure-recovery methods, such as static or greedy channel assignments, and local rerouting. First, ARS’s planning algorithm effectively identifies reconfiguration plans that maximally satisfy the applications’ QoS demands, accommodating twice more flows than static assignment. Next, ARS avoids the ripple effect via QoS-aware reconfiguration planning, unlike the greedy approach. Third, ARS’s local reconfiguration improves network throughput and channel efficiency by more than 26% and 92%, respectively, over the local rerouting scheme.

III. PROPOSED SYSTEM

To overcome the above limitations, we propose an Enhanced autonomous network reconfiguration system (E-ARS) that allows a multiradio WMN (mr-WMN) to autonomously reconfigure its local network settings—channel, radio, and route assignment— for real-time recovery from link failures. An E-ARS is a system that is easily deployed in multi radio wireless mesh network. Running in every mesh node, E-ARS supports self reconfigurability by providing the features such as localized reconfiguration, QoS aware planning, link quality monitoring and cross layer interaction. Based on multiple channels and radio associations available, E-ARS generates reconfiguration plans that allow for changes of network configurations only in the vicinity where link failures occurred while retaining configurations in areas remote from failure locations.

E-ARS accurately monitors the quality of links of each node in a distributed manner and effectively identifies QoS satisfiable reconfiguration plans. Furthermore, based on the measurements and given links' QoS constraints, E-ARS detects local link failures and finally initiates network reconfiguration by introducing the idea of cost effectiveness along with the objective of maximizing the throughput and utilization of the channel.

A. Modules of E-ARS System

The overall modules of E-ARS system are,

i. Network construction
ii. Link-State
iii. Group organizer
iv. Failure detector
v. Gateway planner
  a. Plan generator
  b. QOS filter
  c. benefit filter
vi. Optimal
vii. Analyser

i) Network Construction:

In this module, construct the network as cluster form. It store the node name, data rate and it also maintain the Information about the neighboring nodes .Gateway also involved in it. It will be make detection of route as better.

ii) Link State:

Every node monitors the quality of its outgoing wireless links. The node contains information about the incoming and outgoing traffic. It maintains the information about the neighboring nodes. It measures wireless link conditions via a hybrid link quality measurement technique.

iii) Group Organizer:

It forms a local group among mesh routers. Each router has a specific set of locations from which it can accept data, and a specific set of locations to which it can send data. Mesh routers work by continuously monitoring network activity and maintaining lists of other devices in their vicinity.

iv) Failure Detector:

It interacts with a network monitor in the device driver and maintains an up-to-date link-state table. Network monitor helps to monitors link-quality and extensible to support as many multiple radios as possible.

v) Gateway Planner:

a) Network Planner: It generates needed reconfiguration plans only in a gateway node.

b) QoS Planner: EARS applies strict constraint to identify a reconfiguration plan that satisfies the QoS demands and that improves network utilization most.

c) Benefit Filter: It identifies, which reconfiguration plans are suitable to reach destination.

vi) Optimal:

It identifies, which reconfiguration plan having the shortest path to reach destination. Identifies reconfiguration plans that require the minimum number of changes for the healthy network settings.

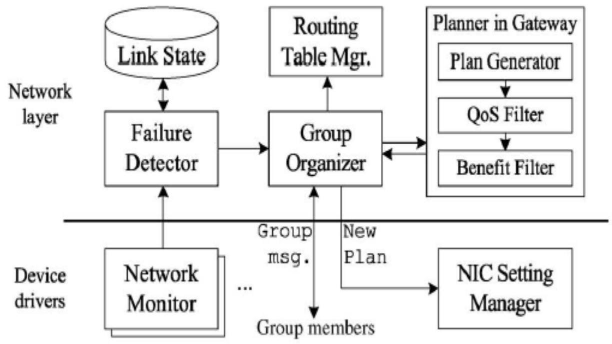

Fig 2: E-ARS software architecture in each node

E-ARS also includes a monitoring protocol that enables a WMN to perform real-time failure recovery in conjunction with the planning algorithm. The accurate link-quality information from the monitoring protocol is used to identify network changes that satisfy applications' new QoS demands or that avoid propagation of QoS failures to neighboring links (ripple effects). Running in every mesh node, the monitoring protocol periodically measures wireless link conditions via a hybrid link-quality measurement technique.

The module in this driver includes: 1) network monitor,which efficiently monitors link-quality and is extensible to support as many multiple radios as possible; and 2) NIC manager, which effectively reconfigures NIC's settings based on a reconfiguration plan from the group organizer.

B. Planning For Localized Network Reconfiguration

In E-ARS, the reconfiguration plan generation and selection process takes place in the gateway. Every mesh node monitors the quality of its outgoing wireless links periodically and reports the results to a gateway. Once it detects a link failure, the gateway synchronizes and generates a reconfiguration plan for the request. The gateway sends the reconfiguration plan to the nodes. Finally, all nodes in the group execute the corresponding configuration changes.

E-ARS systematically generates reconfiguration plans that localize network changes by dividing the reconfiguration planning into four processes i.e. feasible plan generation, QoS test, cost analysis and optimal plan selection. The components of the Enhanced Reconfiguration System are shown in figure 3.

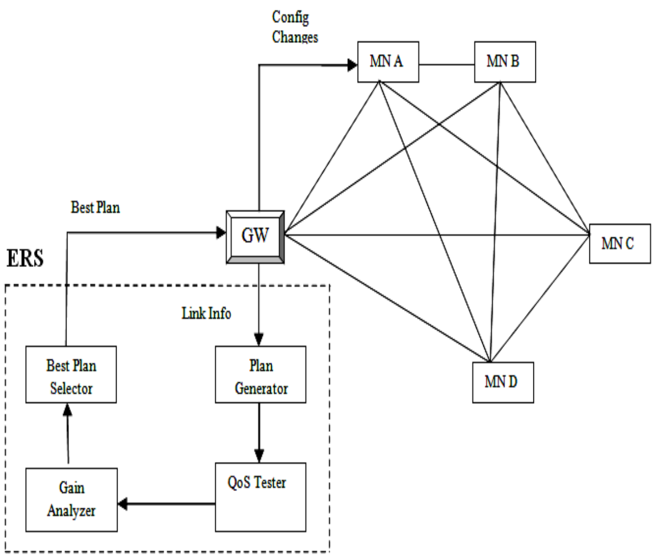

Fig.3 Components of E-ARS

E-ARS first applies connectivity constraints to generate a set of feasible reconfiguration plans (FP) that enumerate feasible channel, link, and route changes around the faulty areas, given connectivity and link failure constraints. Then, within the set, E-ARS applies strict constraints such as QoS and network utilization to identify a reconfiguration plan that satisfies the QoS demands (SP) and that improves network utilization most.

1) Plan Generation Subsystem

Given multiple radios, channels, and routes, E-ARS identifies feasible changes that help avoid a local link failure but maintain existing network connectivity as much as possible. E-ARS has to limit network changes at the same time it needs to find a locally optimal solution by considering more network changes or scope. To make this trade-off, E-ARS uses a k-hop reconfiguration parameter. Figure 4 depicts the operation of feasible plan generation component.

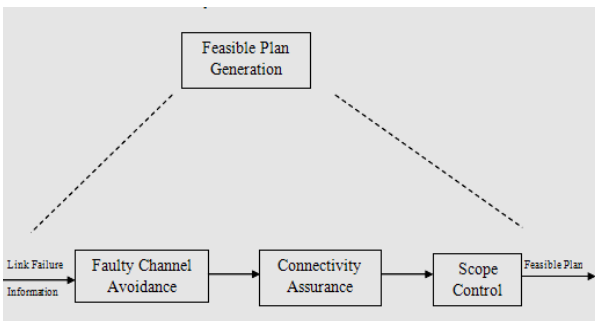

Fig.4 Feasible Plan Generator

Generating feasible plans is essentially to search all legitimate changes in links' configurations and their combinations around the faulty area. Given multiple radios, channels, and routes, E-ARS identifies feasible changes and lists out all possible reconfiguration plans to recover from failure. However, in generating such plans, E-ARS has to address the following challenges.

i. Avoiding a faulty channel
ii. Maintaining network connectivity and utilization
iii. Controlling the scope of reconfiguration changes

i) Avoiding a faulty channel:

E-ARS first has to ensure that the faulty link needs to be fixed via reconfiguration. To this end, E-ARS considers three primitive link changes, as explained in Table 1.

Table 1: Representation Of Link Changes In E-ARS

Primitive changes	Description
Channel switch ($S(A_i, B_j)_{\alpha \to \beta}$)	Radios A_i and B_j of link AB switch their channel (α) to other channel (β).
Radio switch ($R(A_i, B_j)_{\alpha \to \beta}$)	Radio A_i in node A re-associates with radio B_j in node B, tuned in channel (β).
Detouring ($D(A_i, B_j)$)	Both radios A_i and B_j of link AB remove their associations and use a detour path, if exists.

Specifically, to fix a faulty link(s), E-ARS can use: 1) a channel-switch where both end-radios of link AB can simultaneously change their tuned channel; 2) a radio-switch where one radio in node A can switch its channel and associate with another radio in node B; and; 3) a route-switch where all traffic over the faulty link can use a detour path instead of the faulty link.

ii) Maintaining network connectivity and utilization:

While avoiding the use of the faulty channel, E-ARS needs to maintain connectivity with the full utilization of radio resources. Because each radio can associate itself with multiple neighbouring nodes, a change in one link triggers other neighbouring links to change their settings. To coordinate such propagation, E-ARS takes a two-step approach. E-ARS generates feasible changes of each link using the primitives, and then combines a set of feasible changes that enable a network to maintain its own connectivity.

iii) Controlling the scope of reconfiguration changes:

E-ARS has to limit network changes as local as possible, but at the same time it needs to find a locally optimal solution by considering more network changes or scope. E-ARS uses a hop reconfiguration parameter. Starting from a faulty link(s), E-ARS considers link changes within the first hops and generates feasible plans. If E-ARS cannot find a local solution, it increases the number of hops so that E-ARS may explore a broad range of link changes. Thus, the total number of reconfiguration changes is determined on the basis of existing configurations around the faulty area as well as the value of k.

2. QoS Examination

For each feasible plan, E-ARS has to check whether each link's configuration change satisfies its bandwidth requirement, so it must estimate link bandwidth. To estimate link bandwidth, E-ARS accurately measures each link's capacity and its available channel airtime [11].

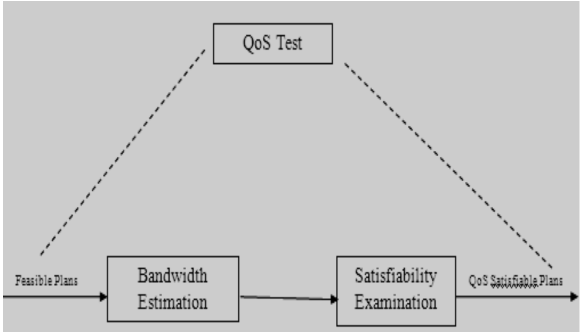

Fig .5 QoS Test Subsystem

Besides the link change, E-ARS needs to check whether neighbouring links are affected. To identify such adverse effect from a plan, E-ARS also estimates the QoS satisfiability of links one hop away from member nodes whose links' capacity can be affected by the plan. If these one hop away links still meet the QoS requirement, the effects of the changes do not propagate. Otherwise, the effects of local changes will propagate, causing cascaded QoS failures. Figure 5 depicts the architecture of the QoS Test subsystem.E-ARS now has a set of reconfiguration plans that are QoS satisfiable and needs to choose a plan within the set for a local network to have evenly distributed link capacity. Among a set of feasible plans, E-ARS now needs to identify QoS-satisfying reconfiguration plans by checking if the QoS constraints.

E-ARS generates per-link changes (gray columns) and then connects them for feasible reconfiguration plans (white columns) for recovery of the failure in each plan. Although each feasible plan ensures that a faulty link(s) will use nonfaulty channels and maintain its connectivity, some plans might not satisfy the QoS constraints or may even cause cascaded QoS failures on neighbouring links. To filter out such plans, E-ARS has to solve the following challenges.

i. Per-Link Bandwidth Estimation
ii. Examining Per-Link Bandwidth Satisfiability
iii. Avoiding Cascaded Link Failures

i) Per-link bandwidth estimation:

For each feasible plan, E-ARS has to check whether each link's configuration change satisfies its bandwidth requirement, so it must estimate link bandwidth. To estimate link bandwidth, E-ARS accurately measures each link's capacity and its available channel airtime. If the information becomes obsolete, E-ARS detects link failures and triggers another reconfiguration to find QoS-satisfiable plans—lazy monitoring.

ii) Examining Per-link bandwidth satisfiability:

Given measured bandwidth and bandwidth requirements, E-ARS has to check if the new link change(s) satisfies QoS requirements. E-ARS defines and uses the expected busy airtime ratio of each link to check the link's QoS satisfiability. Assuming that a link's bandwidth requirement is given, the link's busy airtime ratio (BAR) can be defined as BAR = q / C and must not exceed 1.0 for a link to satisfy its bandwidth requirement.

iii) Avoiding cascaded link failures:

Besides the link change, E-ARS needs to check whether neighboring links are affected by local changes (i.e., cascaded link failures). To identify such adverse effect from a plan, ARS also estimates the QoS-satisfiability of links one hop away from member nodes whose links' capacity can be affected by the plan. If these one-hop-away links still meet the QoS requirement, the effects of the changes do not propagate thanks to spatial reuse of channels. Otherwise, the effects of local changes will propagate, causing cascaded QoS failures.

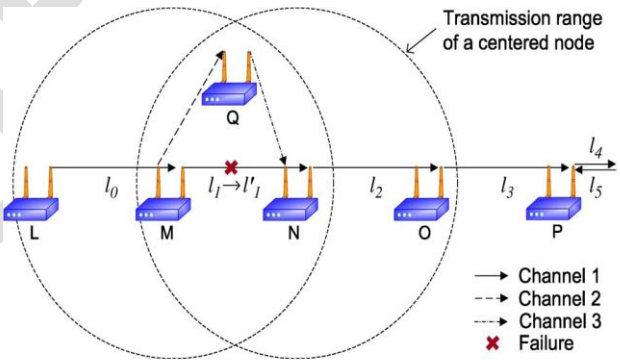

Fig.6 Busy airtime ratio (BAR) of a directed link

Let us consider an example in Fig.6 Assuming BAR of each directed link is 0.2 (e.g., 2 Mb/s 10 Mb/s) in a tuned channel, of each radio tuned to channel 1 does not exceed 1.0, satisfying each link's QoS requirement. In addition, assuming that BAR increases from 0.2 to 0.4 in Fig.6.To accommodate this increase, reconfiguration plans that have a detour path through node Q do not affect the QoS-satisfiability of the neighboring nodes.

3.Optimal Plan Selection

E-ARS now has a set of reconfiguration plans with the reconfiguration cost of each computed. It has to choose a plan within the set based on the cost criterion. The best plan is one which maximizes the utilization as well as throughput and minimizes the total reconfiguration cost. All plans with utilization greater than user defined limit δ are identified and the one with minimum reconfiguration cost is selected as the best plan. Now the reconfiguration changes mentioned in this plan has to be executed by all the nodes.

E-ARS now have a set of reconfiguration plans that are QoS-satisfiable and needs to choose a plan within the set for a local network to have evenly distributed link capacity. However, to incorporate the notion of fair share into the planning, E-ARS needs to address the following challenges.

i. Quantifying the fairness of a plan
ii. Breaking a tie among multiple plans

i) Quantifying the fairness of a plan:

E-ARS has to quantify the potential changes in link-capacity distribution from a plan. To this end, E-ARS defines and uses a benefit function that quantifies the improvement of channel utilization that the reconfiguration plan makes. Specifically, the benefit function is defined as, the relative improvement in the airtime usage of radio, and the number of radios whose has changed from the plan. This definition allows the benefit function to quantify the overall change in airtime usage, resulting from the reconfiguration plan.

ii) Breaking a tie among multiple plans:

Multiple reconfiguration plans can have the same benefit, and E-ARS needs to break a tie among them. E-ARS uses the number of link changes that each plan requires to break a tie. Although link configuration changes incur a small amount of flow disruption (e.g., in the order of 10 ms), the less changes in link configuration, the less network disruption. E-ARS favors a plan that reconfigures links to have 50% available channel airtime and the benefit function considers the plan ineffective, placing the plan in a lowly ranked position.

IV. PERFORMANCE EVALUATION

A. Experimental Results

E-ARS is implemented in a Linux OS and evaluated it in test-bed. Here we described the experimental results and evaluated the improvements achieved by E-ARS, including throughput and channel efficiency, QoS satisfiability, and reduction of ripple effects. E-ARS effectively reconfigures the network on detection of a failure, achieving more bandwidth than static assignment and local rerouting. E-ARS accurately detects a link's QoS-failure using link-quality monitoring information and completes network reconfiguration. E-ARS also improves channel efficiency.

E-ARS identifies feasible changes that helps to avoid a local link failure but maintain existing network connectivity as much as possible. E-ARS is implemented as an agent in both the MAC layer and a routing protocol. It periodically collects channel information from MAC and requests channel switching or link-association changes based on its decision. At the same time, it informs the routing protocol of network failures or a routing table update.

i) Throughput and Channel – Efficiency gains:

In communication networks,such Ethernet or packet radio, network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot. The system throughput or aggregate throughput is the sum of the data rates that are delivered to all terminals in a network.

The throughput can be analysed mathematically by means of queueing theory, where the load in packets per time unit is denoted arrival rate λ, and the throughput in packets per time unit is denoted departure rate μ.

Throughput of a network is given by the number of bits successfully transmitted over the network in a unit time period. Throughput and channel-efficiency gains are studied via E-ARS's real-time reconfiguration and run the UDP flow at a maximum rate over a randomly chosen link in our test-bed while increasing the level of interference every 10 s. The QoS requirement of every link is set to 6 Mb/s and measure the flow's throughput progression every 10 s during a 400-s run. For the purpose of comparison, we also ran the same scenario under the local rerouting with a WCETT metric and static channel-assignment algorithms. E-ARS effectively reconfigures the network on detection of a failure, achieving 450% and 25.6% more bandwidth than static assignment and local rerouting, respectively.

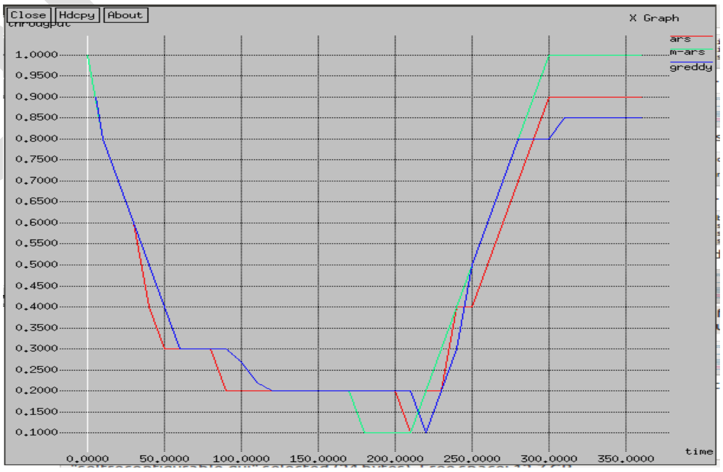

Fig 4.1 Throughput result

E-ARS accurately detects a link's QoS-failure using link-quality monitoring information and completes network reconfiguration (i.e., channel switching) within 15 s on average, while the static assignment experiences severe throughput degradation. Note that the 15-s delay is due mainly to link-quality information update and communication delay with a gateway and the delay can be adjusted.

While considering the throughput for the ARS algorithm, it tends to increase from 7 ms. Since it is the starting time for transmission. Then it will be constant from 8 ms to 9.5 ms because at that time there is no transmission will be occured. Because during this time only the packet dropping and group formation are employed.

Then while considering throughput for E-ARS, it also tends to increase from 7ms. Here also the transmission started from this time only. Then it will be constant from 8 to 8.6 ms then based on the shortest path only links are recovered instead of group formation. So that the time will be reduced and finally the throughput will be high for E-ARS..

E-ARS also improves channel efficiency (i.e., the ratio of the number of successfully delivered data packets to the number of total MAC frame transmissions) by more than 90% over the other recovery methods. E-ARS improves channel efficiency by up to 91.5% over the local rerouting scheme.

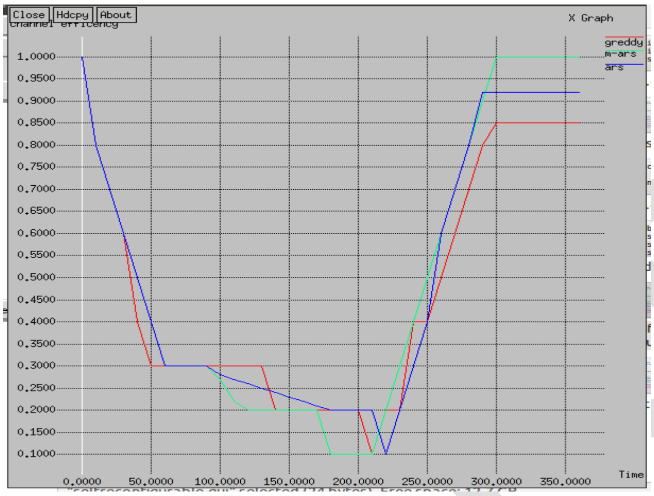

Fig 4.2 Channel Efficiency

On the other hand, using static channel assignment suffers poor channel utilization due to frame retransmissions on the faulty channel. Similarly, the local rerouting often makes traffic routed over longer or low link-quality paths, thus consuming more channel resources than ARS.

ii) Packet Delivery Ratio

The third parameter which is considered is the packet delivery ratio. The packet delivery ratio are generally described by, ratio of received packets by the send packets. At the starting the packet delivery ratio tends to increase while considering both the algorithms.

This is because of the group formation technique employed where as in case of the EARS it produces higher packet delivery ratio at 10 ms its about 0.91. Since the group formation is eliminated in the EARS, it provides higher packet delivery ratio. Packet delivery ratio is plotted time vs packets. E-ARS performance is high compared to the existing methods.

Thus by using E-ARS it autonomously recovers from wireless link failures that require only minimum network configuration changes and thus improving the channel efficiency, throughput and satisfying the new application bandwidth demand

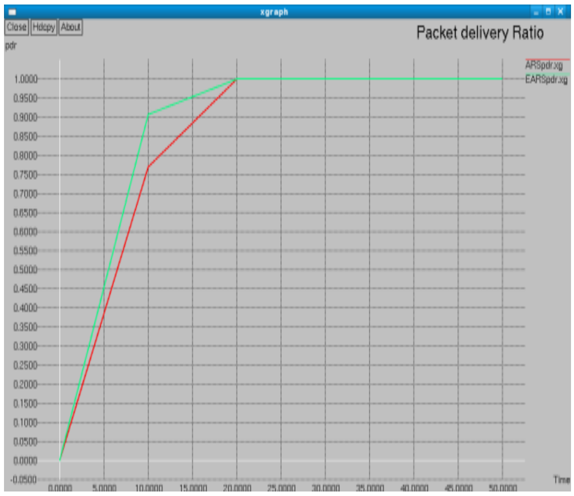

Fig 4.3 Packet Delivery Ratio

. The E-ARS average throughput and efficiency is high compared to the existing recovery methods. The average delay for E-ARS is reduced compared to the existing recovery methods. So the packets are transmitted without delay to the destination when the link failure occurs. Packet delivery ratio is higher in enhanced autonomous reconfiguration method when compared to ARS method.

iii)Channel Utilization

Channel utilization is instead a term related to the use of the channel disregarding the throughput. It counts not only with the data bits but also with the overhead that makes use of the channel. The transmission overhead consists of preamble sequences, frame headers and acknowledge packets.

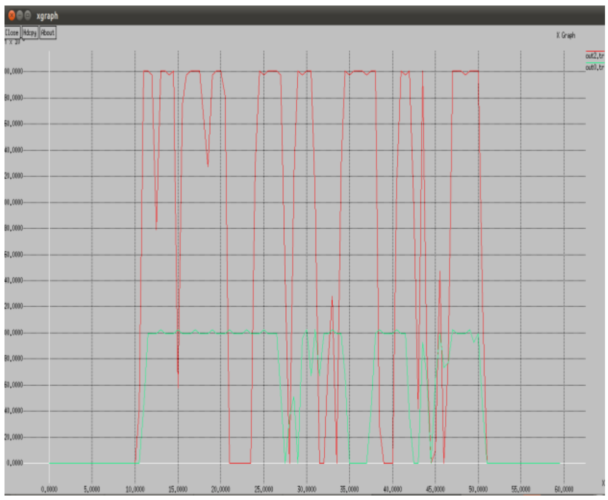
Fig 4.4 Channel Utilization

The definitions assume a noiseless channel. Otherwise, the throughput would not be only associated to the nature (efficiency) of the protocol but also to retransmissions resultant from quality of the channel.

In a simplistic approach, channel efficiency can be equal to channel utilization assuming that acknowledge packets are zero-length and that the communications provider will not see any bandwidth relative to retransmissions or headers. Therefore, certain texts mark a difference between channel utilization and protocol efficiency.The enhanced reconfiguration system further refines the process of the selecting the best reconfiguration plan by introducing the idea of cost effectiveness along with the objective of maximizing the throughput and utilization of the channel.

Channel utilization or channel efficiency, also known as bandwidth utilization efficiency, in percentage is the achieved throughput related to the net bitrate in bit/s of a digital communication channel. For example, if the throughput is 70 Mbit/s in a 100 Mbit/s Ethernet connection, the channel efficiency is 70%.

iv) Packet Drop

The information transmission starts from the source node to the destination node. While transmitting the link failures are occurred. Due to this link failure the packet dropping took place.

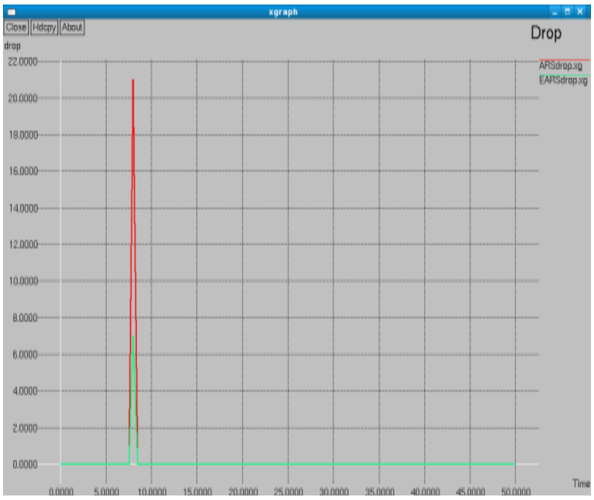

Fig 4.5 Packet drop

This graph shows that the packet dropping occurred by the Autonomous Reconfigurable System (ARS) is about 21.These packet dropping can be reduced by employing the Enhanced Autonomous Reconfigurable System (E-ARS) algorithm. Here the packet dropping occurred is 7. Connectivity Assurance is essential that E-ARS maintains connectivity with the full utilization of radio resources.

E-ARS also maximizes the usage of network resources. This is achieved by making each rado of a mesh node associate itself with at least one link and by avoiding the use of same channel among radios in one node.

E-ARS now has a set of reconfiguration plans with the reconfiguration cost of each computed. It has to choose a plan within the set based on the cost criterion. The best plan is one which maximizes the utilization as well as throughput and minimizes the total reconfiguration cost. Now the reconfiguration changes mentioned in this plan has to be executed by all the nodes.

ARS effectively reconfigures the network on detection of a failure, achieving more bandwidth than static assignment and local rerouting. ARS accurately detects a link's QoS-failure using link-quality monitoring information and completes network reconfiguration. ARS also improves channel efficiency. ARS identifies feasible changes that help avoid a local link failure but maintain existing network connectivity as much as possible. ARS is implemented as an agent in both the MAC layer and a routing protocol. It periodically collects channel information from MAC and requests channel switching or link-association changes based on its decision. At the same time, it informs the routing protocol of network failures or a routing table update.

V. CONCLUSION

In this paper, the link failure recovery is considered as the main phenomenon. It is done by using Autonomous Reconfigurable System algorithm. Though this algorithm provides link recovery, some kinds of limitations such as high drop, low throughput etc, are produced. These are due to the group formation technique which is employed from the failure occurred node. In order to overcome from this limitations, a new enhanced algorithm called as Enhanced Autonomous Reconfiguration algorithm (EARS) is used. These provides low packet drop, high throughput etc. Only the energy consumption is more compared to Autonomous Reconfigurable System (ARS) algorithm. This is because the traffic is increased compared to the Autonomous Reconfigurable System algorithm.

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