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Fast And Accurate Autonomous Network Self-Configuration In Wireless Mesh Network

D.Philipdevakumar[1], Guntapali Manojkumar[2]

M.E Finalyear Indira Institute Of Engineering and Technology[1], M.E Finalyear Indira Institute Of Engineering and Technology[2]

pdk.philip@gmail.com[1], manoj.kumar6060@gmail.com[2]

ABSTRACT— ***Muiltihop Wireless Mesh networks results in failures cause by channel interface and application bandwidth demands. More over there is a severe performance degradation in Wireless Mesh networks due to link failure which is very difficult to recover. In order to overcome this failure Fast and Accurate Autonomous Network Reconfiguration System (FAARS) enables a multiradio Wireless Mesh networks to autonomously recover local link failure by generating changes in local radio and channel assignments. Fast and Accurate Autonomous Network Reconfiguration System ensures recovery of link failure in Wireless Mesh networks in minimal time with maximum accuracy without compromising channel efficiency and application bandwidth demand.***

*Keywords*² **FAARS, Wireless Mesh Network, Mulriradio wireless, Channel efficiency, Application bandwidth.**

I. Introduction

Wireless mesh networks (WMNs) are being developed actively and deployed widely for a various applications, such as citywide wireless Internet services, public safety, environment monitoring. For an assumption, some links of a WMN may experience significant channel interference from other coexisting wireless mesh networks. Some patrial parts of networks might not be able to meet increasing bandwidth demands from new mobile users and applications. Wireless mesh networks to recover from wireless link failures have been suggested, they still have many restrictions as follows. First, resource-allocation algorithms may provide (theoretical) assessments for initial network resource planning. Anyhow, even though their approach gives a comprehensive and optimal network FRQILJXUDWLRQSODQ,WKH\RIWHQUHTXLUH ³JOREDO´ configuration changes, which are undesirable in case of frequent local link failures. Then, 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, like local rerouting / multipath routing can be adopted to use network level path diversity for prevents the affected 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 with an effective time optimization, we propose an *fast and accurate autonomous network reconfiguration system* (FAARS) that allows a multiradio WMN (mr-WMN) to autonomously reconfigure its local network settings²channel, radio, and route assignment²for real-time recovery from link failures with minimal time. FAARS 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, FAARS identifies reconfiguration plans that require the minimum number of changes for the healthy network settings. Next, FAARS also includes a monitoring protocol that enables a Wireless Mesh Network to perform real-time failure (fault) recovery in proposition with the planning algorithm. The fast and accurate link-quality intimates from the monitoring protocol is availed to identify network modifications WKDW VDWLVI\ DSSOLFDWLRQV¶ whose new

QoS demands or that avoids propagation of QoS failures to neighbouring links FAARS detects link failures and/or generates QoS-aware network reconfiguration plans upon detection of a link failure.

II. RELATED TASK

Multiradio WMN: A network is deceived to consist of mesh nodes, one control gateway and IEEE 802.11-based wireless links. Each mesh node is availed with radios, and each link assessments and radiR¶V channel are initialled by using global channel or link assignment

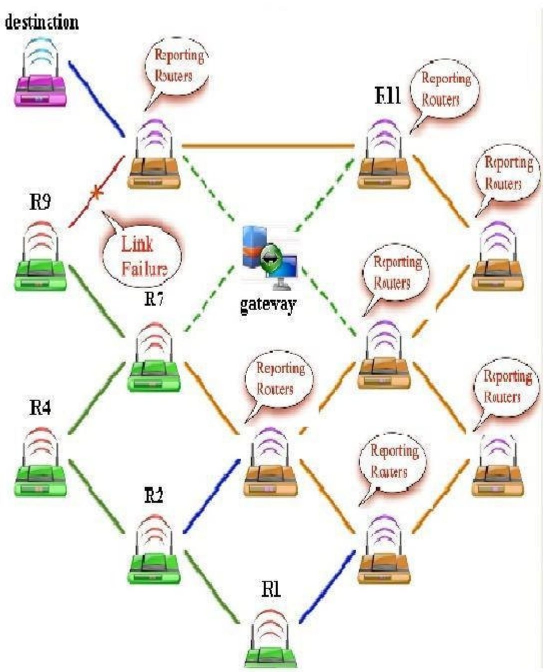


Fig. 1. Multiradio WMN.

A Wireless Mesh Network has an initial assignment of frequency channels as described. The network periodically experiences wireless link failure and needs to reconfigure its settings. QoS Support: During its operation, each mesh node in a time interval sends its local channel usage and the quality information for all out passing links by management messages to the control gateway. Then, based on this information, the gateway controls the admission of requests for voice or video flows. For admitted flows, the information about QoS requirements is delivered to its flexibility by considering both radio diversity and local traffic information. For example, in Fig. 1, if channel 5 is lightly loaded in a faulty area, the second radio of node can reassociate itself with the first radio of node, avoiding configuration changes of other links. QoS-Awareness: Reconfiguration has to satisfy QoS constraints on the entire link as possible. Initially, JLYHQHDFKOLQN¶V bandwidth optimization, existence channel-assignment and scheduling algorithms provide parasail optimal network configurations. Anyhow, as indicated 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.

Cross-Layer Interaction: Network reconfiguration has to collectively consider network context across multi session layers. At the network layer, fault-tolerant routing protocols, such as nearby rerouting or multipath routing allow for flow reconfiguration to meet the QoS constraints by exploiting path detouring. Anyhow, they consume large network resources than link reconfiguration due to their belief on detour paths or redundant transmissions. On the other side, channel and link assignments over the network and link layers can prevent from the overhead of detouring, but they have to take interference into account to avoid additional QoS failures of neighbouring nodes.

III. FAARS ARCHITECTURE

FAARS is a distributed system that is easily deployable in IEEE 802.11-based mr-WMNs. running in every mesh node, FAARS supports self-reconfigurability via the following distinct features.

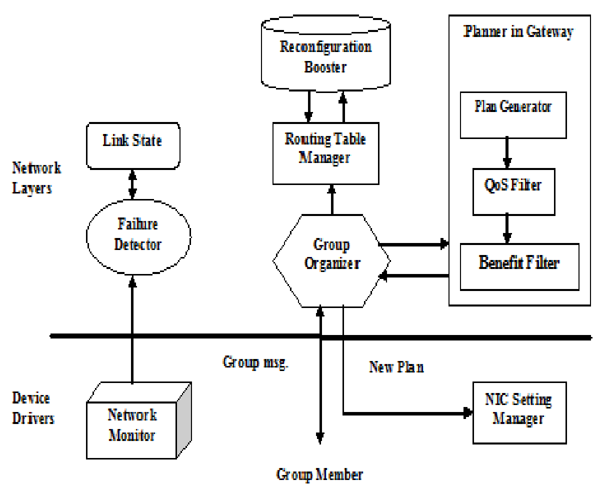


Fig 2.FAARS Software architecture in each node

‡Localized reconfiguration: Based on the multiple channels and radio associations available, FAARS generates autonomous reconfiguration plans that opens up for changes of network configurations only in the areas where link failures occurred while pertaining configurations in sectors identified in failure locations.

‡ Cross-layer interaction: FAARS actively interacts across the network and link layers for planning. This interaction enables FAARS to include a rerouting for reconfiguration planning in addition to link-layer reconfiguration. FAARS can also maintain connectivity during recovery period with the help of a routing protocol.

‡ QoS-aware planning: FAARS effectively identifies QoS-satisfiable reconfiguration plans by1) estimating the QoSsatisfiability of generated reconfiguration plans; and 2) deriving their expected benefits in channel utilization. Autonomous reconfiguration via link-quality monitoring: FAARS accurately monitors the quality4 of links of each node in a distributed manner. To take forward the measurements and given linkV¶ 4R6 FRQVWUDLQWV, FAARS detects local link failures and autonomously initiates network reconfiguration.

IV. FEASIBLE PLAN GENERATION

Widely feasible plans are essentially to seek all hereditary FKDQJHV LQ OLQNV¶ FRQILJXUDWLRQs and their association, in and around the affected area. Given multiple radios, channels, and routes, FAARS identifies feasible changes that help avoid a local link failure but maintain existing network connectivity as much as possible. However, in generating such plans, FAARS has to address the following challenges.

‡ Hindering a faulty channel: FAARS first has to ensure that the faulty link needs to be fixed via reconfiguration. To this end, FAARS considers three primitive link changes, as explained in detail. Specifically, to fix a faulty link(s), FAARS can use

(1) a channel-switch (S) where both end-radios of link XY can simultaneously change their tuned channel,

(2) a radioswitch (R) where one radio in node X can switch its channel and associate with another radio in node Y, and

(3) a routeswitch (D) where all traffic over the faulty link can use a detour path, instead of the faulty link.

‡ Maintaining network connectivity and utilization: While avoiding the use of the faulty channel, FAARS 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, FAARS takes a two-step approach. FAARS first generates feasible changes of each link using the primitives.

V. RECONFIGURATION BOOSTER

Based on the update state of a system routing table an reconfiguration plan is generated. Based on that plan an election is conducted between the nodes to identify the leader node after the link failure occurs it is done using Bully algorithm. It minimize the time of reconfiguration of link failure in wireless mesh network with maximum accuracy without compromising channel efficiency and application band with demand.

VI. FAARS ALGORITHM

Algorithm 1 FAARS Operation at mesh node i

(1) Monitoring period (t_{m})
for every link j **do**
    measure link-quality (lq) using passive monitoring;
end for
send monitoring results to a gateway g;
(2) Failure detection and group formation period (t_{f})
if link l violates link requirements r **then**
    request a group formation on channel c of link l;
end if
participate in a leader election if a request is received;
(3) Planning period (M, t_{p})
if node i is elected as a leader **then**
    send a planning request message (c, M) to a gateway;
else if node i is a gateway **then**
    synchronize requests from reconfiguration groups M_n
    generate a reconfiguration plan (p) for M_i;
    send a reconfiguration plan p to a leader of M_i;
end if
(4) Reconfiguration Boost (p, t_{r})
if p includes changes of node i **then**
    apply the changes to links at t;
end if
relay p to neighboring members, if any

Algorithm describes the operation of FAARS. In beginning, FAARS in every mesh node monitors the quality of its outgoing wireless links at every and reports the results to a gateway via a management message. Second, once link failure(s) are detected, FAARS in the detector node(s) triggers the formation of a group among local mesh routers that use a faulty channel, and one of the members in group is elected as a leader using the well-known bully algorithm for coordinating the reconfiguration. After identifying the link failure(s) the leader node sends a planning-request message to a gateway. After receiving the message the gateway synchronizes the planning requests, if there are multiple requests it will autonomously generates a reconfiguration plan for the request. Then, the gateway sends a reconfiguration plan to the leader node and the group members. At last, all nodes in the group execute the corresponding configuration changes, if any, and resolve the group.

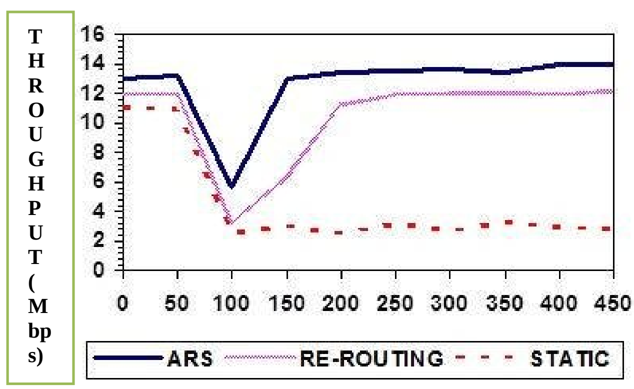
VII. IMPLEMENTATION DETAILS

Fig.2 shows the software architecture of FAARS. First, FAARS in the network layer is implemented using netfilter [32], which provides FAARS with a hook to capture and send FAARS-related packets such as group-formation messages. In addition, this module includes several important algorithms and protocols of FAARS: 1) *network planner*, which generates reconfiguration plans only in a gateway node; 2) *group organizer*, which forms a local group among mesh routers; 3) *failure detector*, which periodically interacts with a network monitor in the device driver and maintains an up-to-date link-state table; and 4) *routing table manager*, through which FAARS obtains or updates states of a system routing table.5) *reconfiguration booster*, An election is conducted between the nodes to identify the leader node after the link failure occurs it is done using Bully algorithm(Identification of leader nodes).
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 reconILJXUHV 1,&¶V VHWWLQJV based on a reconfiguration plan from the group organizer.

VIII. EXPERIMENTAL RESULTS

Experimental Results We evaluated the improvements achieved by FAARS, including throughput and channel efficiency, QoS satisfiability, and reduction of ripple effects.
1) Throughput and Channel-Efficiency Gains: We first study throughput and channel-efficiency gains via FA$56¶V UHDO-time reconfiguration. We run one UDP flow at a maximum rate over a randomly chosen link in our test-bed while increasing the level of interference every 10 s. We also set the QoS requirement of every link to 7 Mb/s and measure the IORZ¶V WKURXJKSXW SURJUHVVLRQ HYHU\ __ V GXULQJ I
400-s run
2) QoS Satisfaction Gain: FAARS enhances the chance to meet the varying QoS demands. To show this gain, we first assign links and channels in our test-bed as in fig 1. Here, nodes G, A, and C are a gateway, a mesh router in a conference room, and a mesh router in an office, respectively. We assume that mobile clients in the conference room request video streams through the router A during analysis meeting, and after the analysis meeting, they return to the office room and connect to the router C. While increasing the number of video streams, we measure the total number of admitted streams after network reconfiguration for each place. FAARS generates changes in local radio and channel assignments in order to recover from the failures. By using the FAARS it results in existing failure recovery can be improved by channel-efficiency and application bandwidth demands.

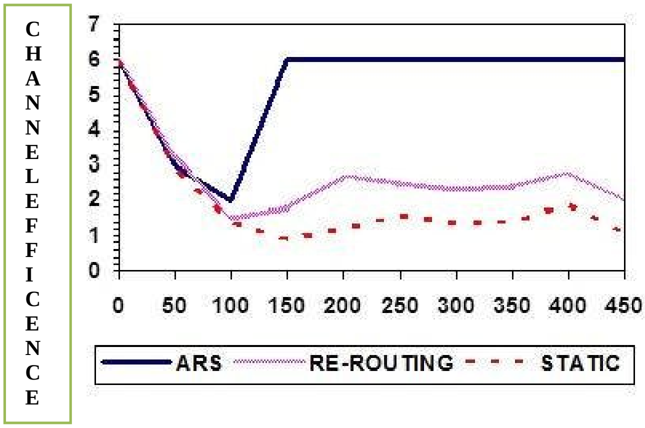
IX. PERFORMANCE EVALUATION



Time(s)
(a) Throughput gains

We run one UDP flow at a maximum rate over a randomly-chosen link in our testbed, while increasing the level of interference every 10 seconds. We also set the QoS requirement of every link to 7 Mbps, and

PHDVXUH WKH IORZ¶s throughput progression every 10 seconds during a 400-second run.



Time(s)

(b) Channel-efficiency gains

Channel-efficiency gains. FAARS effectively reconfigures the network around a faulty link, improving both network throughput and channel efficiency. FAARS reconfigures a wireless mesh network to meet different QoS requirements. Before each reconfiguration, the gray areas can only accept 1 to 9 UDP flows. On the other hand, after reconfiguration, the network in the areas can admit 4 to 15 additional flows, improving the average network capacity of the gray areas by 3.5 times.

X. CONCLUSION

A. Concluding Remarks

This paper gives an insight in to the autonomous recovery from wireless link failure in wireless mesh network by ARS, without time and accuracy constraints. But by using this innovative Fast and Accurate Autonomous Network Reconfiguration System (FAARS) we can reconfigure link failures in wireless mesh networks in minimal time with maximum accuracy.

B. Future Enhancement

Joint optimization with flow assignment and routing: ARS decouples network reconfiguration from flow assignment and routing. Reconfiguration might be able to achieve better performance if two problems are jointly considered. Even though there have been a couple of proposals to solve this problem they only provide theoretical bounds without considering practical system issues. Even though its design goal is to recover from network failures as a best-effort service, FAARS is the first step to solve this optimization problem, which we will address in a forthcoming paper

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Biography

D.Philipdevakumar is pursuing his Master of Engineering from department of Computer Science and Engineering at Indira Institute of Engineering and Technology and completed his

Bachelor of Engineering from department of Computer Science and Engineering at the same Institution and he have also completed his Diploma in Computer Science and Engineering and his research interest includes wireless networks, Parallel and distributed computing ,Secured computing, Network Security, Internet Technology.

Guntapali Manojkumar is pursuing his Master of Engineering from department of Computer Science and Engineering at Indira Institute of Engineering and Technology and finished his Bachelor of Engineering from department of Computer Science and Engineering at the Dhanalakshmi Srinivasan college of Engineering and Technology and his research interest includes mobile data management, wireless networks, and Internet technology.