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Implementation of ARS-STR in STR for Effective Energy Transmission

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Abstract - **Wireless mesh networks (WMNs) have emerged as a key technology for next generation wireless networking. Because of their advantages over other wireless networks, WMNs are undergoing rapid progress and inspiring numerous applications. In multi-hop wireless mesh networks (WMNs) experience frequent link failures caused by channel interference, dynamic obstacles and/or applications bandwidth demands. These failures cause severe performance degradation in WMNs or require expensive, manual network management for their real-time recovery. This paper presents an Autonomous network Reconfiguration System (ARS-STR) that enables a multi-radio WMN to autonomously recover from local link failures to preserve network performance. ARS-STR also improves channel efficiency.**

Keywords : **ARS - STR, WMNs, Energy Transmission**

I. Introduction

Wireless networks provide unprecedented freedom and mobility for a growing number of laptop and PDA users who no longer need wires to stay connected with their workplace and the Internet. The devices that provide wireless service to these clients need lots of wiring themselves to connect to private networks and the Internet. This white paper presents a viable alternative to all those wires - the wireless mesh network. Unlike basic Wi-Fi that simply unfetters the client; the wireless mesh unfetters the network itself giving IT departments, network architects and systems integrators unprecedented freedom and flexibility to build out networks in record time with high performance and without the expensive cabling.

A. Wireless Mesh Networks

A wireless mesh network (WMN) is a communications network made up of radio nodes organized in a mesh topology. Wireless mesh networks 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. The animation below illustrates how wireless mesh networks can self form and self heal. Wireless mesh networks can be implemented with various wireless technology including 802.11, 802.15, 802.16 cellular technologies or combinations of more than one type.

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 multi radio/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.

B. Adhoc Network

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.

An ad-hoc network, on the other hand, is formed ad hoc when wireless devices come within communication range of each other. The mesh routers may be mobile, and be moved according to specific demands arising in the network. Often the mesh routers are not limited in terms of resources compared to other nodes in the network and thus can be exploited to perform more resource intensive functions. In this way, the wireless mesh network differs from an ad-hoc network, since these nodes are often constrained by resources.

Fact Finding is the methods of gathering the information required about the existing system. Some of them are as follows.

- Observation
- Record Searching
- Special purpose Records
- Sampling
- Questionnaires
- Interviewing

Observation of the current work situation will provide clues to problems and atmosphere.

Record searching, special purpose records and sampling will give quantitative information about the system which facilitates sizing of the proposed system and may also point the areas of difficulties which are being experienced.

Questionnaires can be used to collect the quantifiable data about the system. All of the techniques need to be supplemented by more detailed discussion of the interview situation. The identification of the user requirements, decision areas, objectives and responsibilities for certain procedures can only be achieved for interviewing.

Based on the above fact finding techniques, it is observed the current situation of the existing system. It is very helpful to finding the areas of difficulties, which are being experienced in the existing system. Thus it helps to develop the proposed system with the quantifiable data.

C. Input Design

Input Design is part of overall system design, which requires very careful attention. If the data going into the system is incorrect then the processing and output will magnify these errors.

The inputs in the system are of three types:

- External : which are prime inputs for the system
- Internal : which are user communication with the system
- Interactive : which are inputs entered during a dialog with the computer

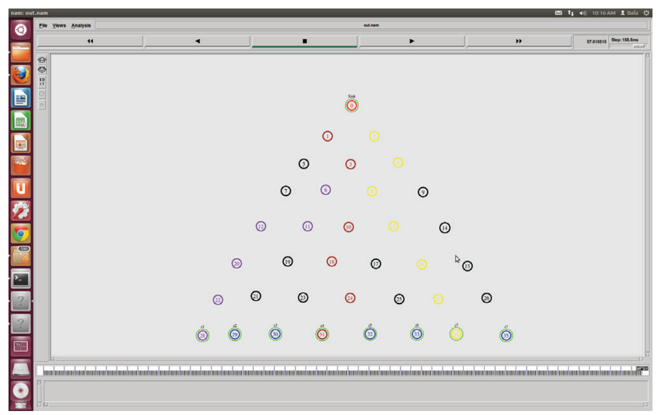


Fig. 1 Input Design

The above input types enrich the proposed system with numerous facilities that make it more advantageous in comparison with the exiting normal system. All the inputs entered are completely raw, initially, before being entered into a database, each of them available processing. The input format in this system has been designed with the following objectives in mind.

II. Feasibility Analysis

All projects are feasible, given unlimited resources and infinite time. Before going further in to the steps of software development, the system analyst has to analyze whether the proposed system will be feasible for the organization and must identify the customer needs. The main purpose of feasibility study is to determine whether the problem is worth solving. The success of a system is also lies in the amount of feasibility study done on it. Many feasibility studies have to be done on any system.

But there are three main feasibility tests to be performed. They are

- Operation Feasibility
- Technical Feasibility
- Economic Feasibility

A.Operational Feasibility

During feasibility analysis operational feasibility study is a must. This is because; according to software engineering principles operational feasibility or in other words usability should be very high. A thorough analysis is done and found that the system is operational.

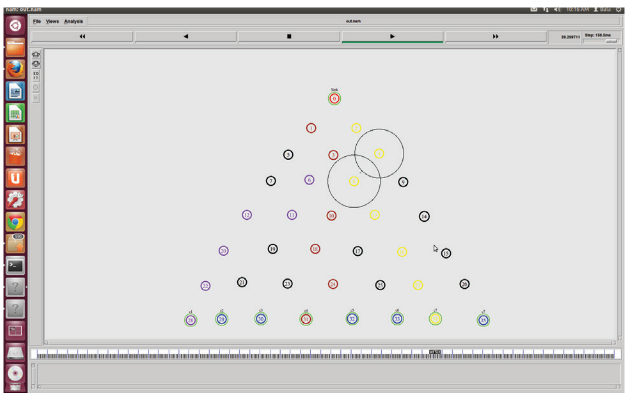


Fig. 2 Operational Feasibility

B.Technical Feasibility

The system analyst to check the technical feasibility of the proposed system. Taking account of the hardware it is used for the system development, data storage, processing and output, makes the technical feasibility assessment. The system analyst has to check whether the company or user who is implementing the system has enough resource available for the smooth running of the application. Actually the requirements for this application are very less and thus it is technically feasible.

C. Economical Feasibility

Before going further in to the development of the proposed system. The system analyst has to check the economic feasibility of the proposed system and the cost for running the system is composed with the cost benefit that can achieve by implementing the system. As in the case of Crypto Media development cost is not high, as it doesn't need any extra hardware and software. Thus the system is economically feasible.

System design is process of planning a new system to document or altogether replace the old system. The purpose of the design phase is to plan a solution for the problem. The phase is the first step in moving from the problem domain to the solution domain. The design of the system is the critical aspect that affects the quality of the software. System design is also called top-level design. The design phase translates the logical aspects of the system into physical aspects of the system.

III. Autonomous Reconfiguration System

A reconfiguration plan is defined as a set of links configuration changes necessary for a network to recover from a link failure on a channel, and there are usually multiple reconfiguration plans for each link failure. ARS-STR systematically generates reconfiguration plans that localize network changes by dividing the reconfiguration planning into three processes - feasibility, QoS satisfiability, and optimality and applying different levels of constraints.

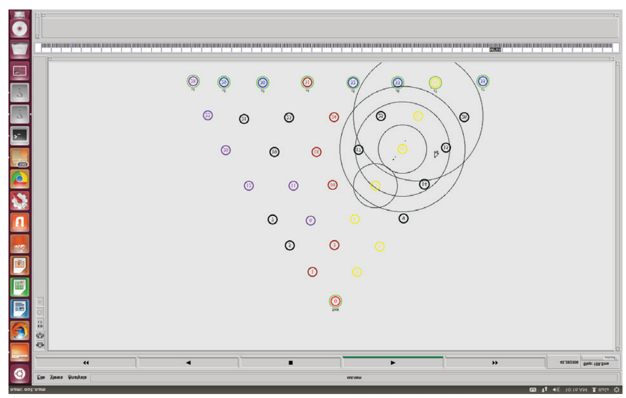


Fig. 3 Autonomous Recontiguration System

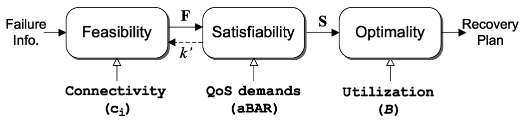
ARS-STR first applies connectivity constraints to generate a set of feasible reconfiguration plans that enumerate feasible channel, link, and route changes around the faulty areas, given connectivity and link-failure constraints. Then, within the set, ARS-STR applies strict constraints (i.e., QoS and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

A. Localized Reconfiguration

Based on multiple channels and radio associations available, ARS-STR 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.

B. QoS Aware Planning

ARS-STR effectively identifies QoS-satisfiable reconfiguration plans by estimating the QoS satisfiability of generated reconfiguration plans and deriving their expected benefits in channel utilization.



C. Autonomous Reconfiguration Via Link-Quality Monitoring

ARS-STR accurately monitors the quality of links of each node in a distributed manner. Furthermore, based on the measurements and given links' QoS constraints, ARS-STR detects local link failures and autonomously initiates network reconfiguration.

D. Cross-Layer Interaction

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

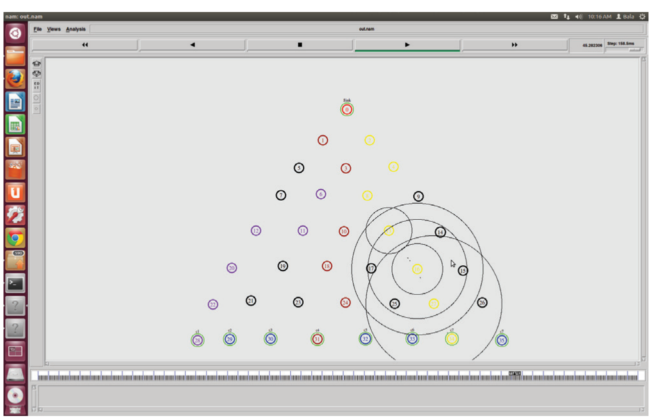


Fig. 4 Cross Layer Interaction

Algorithm describes the operation of ARS-STR. First, ARS-STR in every mesh node monitors the quality of its outgoing wireless links at every (e.g., 10 s) and reports the results to a gateway via a management message. Second, once it detects a link failure(s), ARS-STR in the detector node(s) triggers the formation of a group among local mesh routers that use a faulty channel, and one of the group members is elected as a leader using the well-known bully algorithm [29] for coordinating the reconfiguration. Third, the leader node sends a planning-request message to a gateway. Then, the gateway synchronizes the planning requests—if there are multiple requests—and generates a reconfiguration plan for the request. Fourth, the gateway sends a reconfiguration plan to the leader node and the group members. Finally, all nodes in the group execute the corresponding configuration changes, if any, and resolve the group. We assume that during the formation and reconfiguration, all messages are reliably delivered via a routing protocol and per-hop retransmission timer.

E. Planning For Localized Network Reconfiguration

The core function of ARS-STR is to systematically generate localized reconfiguration plans. A reconfiguration plan is defined as a set of links' configuration changes (e.g., channel switch, link association) necessary for a network to recover from a link(s) failure on a channel, and there are usually multiple reconfiguration plans for each link failure. Existing channel-assignment and scheduling algorithms seek "optimal" solutions by considering tight QoS constraints on all links, thus requiring a large configuration space to be searched and hence making the planning often an NP-complete problem .

In addition, change in a link's requirement may lead to completely different network configurations. By contrast, ARS-STR systematically generates reconfiguration plans that localize network changes by dividing the reconfiguration planning into three processes—feasibility, QoS satisfiability, and optimality—and applying different levels of constraints. ARS-STR first applies connectivity constraints to generate a set of feasible reconfiguration plans that enumerate feasible channel, link, and route changes around the faulty areas, given connectivity and link-failure constraints. Then, within the set, ARS-STR applies strict constraints (i.e., QoS and network utilization) to identify a reconfiguration plan that satisfies the QoS demands and that improves network utilization most.

F. Feasible Plan Generation

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, ARS-STR identifies feasible changes that help avoid a local link failure but maintain existing network connectivity as much as possible.

G. Maintaining Network Connectivity and Utilization

While avoiding the use of the faulty channel, ARS-STR 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, ARS-STR takes a two-step approach.

ARS-STR first 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. Furthermore, for the combination, ARS-STR maximizes the usage of network resources by making each radio of a mesh node associate itself with at least one link and by avoiding the use of same (redundant) channel among radios in one no

H. Controlling The Scope of Reconfiguration Changes

ARS-STR 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. To make this trade off, ARS-STR uses a -hop reconfiguration parameter. Starting from a faulty link(s), ARS-STR considers link changes within the first hops and generates feasible plans. If ARS-STR cannot find a local solution, it increases the number of hops so that ARS-STR 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.

I. Per-Link Bandwidth Estimation

For each feasible plan, ARS-STR has to check whether each link's configuration change satisfies its bandwidth requirement, so it must estimate link bandwidth. To estimate link bandwidth, ARS-STR accurately measures each link's capacity and its available channel airtime. In multi-hop wireless networks equipped with a CSMA-like MAC, each link's achievable bandwidth (or throughput) can be affected by both link capacity and activities of other links that share the channel airtime. Even though numerous bandwidth-estimation techniques have been proposed, they focus on the average bandwidth of each node in a network or the end-to-end throughput of flows , which cannot be used to calculate the impact of per-link configuration changes.

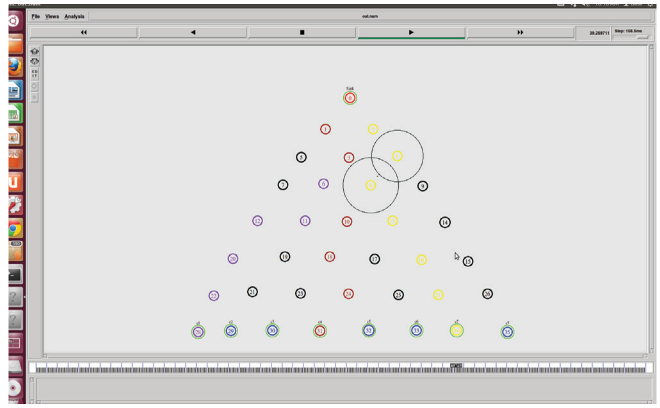


Fig. 5 Per Link Bandwidth Estimation

By contrast, ARS-STR estimates an individual link's capacity based on measured (or cached) link-quality information - packet-delivery ratio and data-transmission rate measured by passively monitoring the transmissions of data or probing packets - and the formula derived in the Appendix. Here, we assume that ARS-STR is assumed to cache link-quality information for other channels and use the cached information to generate reconfiguration plans. If the information becomes obsolete, ARS-STR detects link failures and triggers another reconfiguration to find QoS-satisfiable plans.

IV. Conclusion

An autonomous network reconfiguration system (ARS-STR-STR) that enables multiradio WMN to autonomously recover from wireless link failures. ARS-STR-STR generates an effective reconfiguration plan that requires only local network configuration changes by exploiting channel, radio, and path diversity. Furthermore, ARS-STR-STR effectively identifies reconfiguration plans that satisfy applications QoS constraints, admitting up to two times more flows than static assignment, through QoS aware planning. ARS-STR-STR's online re-configurability allows for real-time failure detection and network reconfiguration, thus improving channel efficiency.

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