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SELF-HEALING USING BACKBONE

ROSY PAWAR
ASST. PROFESSOR
DEPARTMENT OF COMPUTER SCIENCE & APPLICATIONS
KURUKSHETRA UNIVERSITY
KURUKSHETRA

DR. ASHOK KUMAR
ASSOCIATE PROFESSOR
DEPARTMENT OF ELECTRONICS
D. A. V COLLEGE
AMBALA CITY

ABSTRACT

Wireless networking is a new emerging era. It has potential applications in extremely unpredictable and dynamic environments. Individuals and industries choose wireless because it allows flexibility of location, whether that means mobility, portability, or just ease of installation at a fixed point. The challenge of wireless communication is that, the environment that wireless communications travel through is unpredictable. Despite early problems in overcoming this pitfall, the newest developments in self-healing wireless networks are solving the problem. Wireless networks that fix their own broken communication links may speed up their widespread acceptance. The changes made to the network architectures are resulting in new methods of application design for this medium. The paper presents a view on Self-healing networks and concept of backbone nodes have been given for basic problems of stable routing in wireless networks.

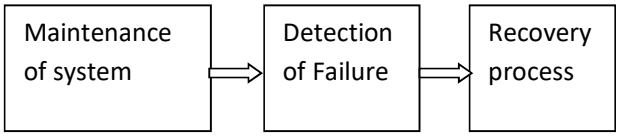
KEYWORDS

wireless networking, wireless communication.

1.0 INTRODUCTION

There is tremendous technological advance in producing small and smart devices. The number of embedded devices in appliances and vehicles is increasing at a rapid rate. Thousands of such devices can be used for applications[1,5] like: environmental data collection, weather forecasting, measuring toxicity levels at hazardous sites etc. It is a natural consequence that such devices work in a collaborative way. However, users carry around many such smart devices and they are not fixed in the sense of a desktop computer. Hence, there is a need for networking such mobile devices without any infrastructural support. There is a growing demand of using networks of mobile devices[2] anywhere and anytime. Cellular Phones and Internet provide some soluiton, but Cellular phones work with infrastructural support like mobile phone towers and satellite communication. However, such support comes at a cost like pre-registration with a mobile service provider etc. In many situations, the Internet may not be an efficient solution. For example, a collection of people trying to communicate in a hotel or conference hall. Adhoc network provide a solution to these problems. An ad hoc network is a collection of autonomous nodes, which may move arbitrarily so that the topology changes frequently. In contrast to conventional wireless networks, the nodes in Mobile ad hoc network communicate using wireless links without any fixed network infrastructure and centralized administrative support [14]. A node act both as source/destination for messages and as a switching or routing node. The purpose of an ad hoc network is to set up (possibly) a short-lived network for a collection of nodes. If all the wireless nodes are within the transmission range of each other, routing is easy. Every node can listen to all transmissions. However, this is not true in most situations, due to short transmission range. Hence, most ad hoc neworks are multi-hop [3, 5]. A message from a source node must go through intermediate nodes to reach its destination. All nodes cooperate in delivering messages across the network. A major problem of ad hoc network is route stability as mobility has a significant effect on network integrity. Link failures lead to a considerable packet loss in data transmission. In this paper a new proposal based on backbone nodes has been introduced to make route stable and follow the concept of self healing. Rest of paper is organised as : Section 2 highlights major issues of ad hoc network, Section 3 gives a detailed survey of self healing networks with techniques, proposed scheme is part of section IV and results and discussion have been made in section V. A simple recovery cycle is denoted in figure 1.

FIGURE 1: SELF HEALING CYCLE



Critical issues [4, 11] in self-healing systems typically include maintenance of system health, recovery processes to return the state from an unhealthy state to a health one. Self-healing components or systems typically have the following characteristics [11]: (a) perform the productive operations of the system, (b) coordinate the activities of the different agents, (c) control and audit performance, (d) adapt to external and internal changes and (e) have policies to determine the overall purpose of the system.

Most of the self-healing concepts are still in very early stages; still some possible areas explored are grid computing, software agents, middleware computing, ad hoc networks. Emphasis here is on ad hoc network self-healing characteristics. Thrust areas considered here are in routing and energy efficiency.

A) SELF HEALING IN ROUTING

The most promising developments in the area of self-healing wireless networks are ad hoc networks. They are decentralized, self-organizing, and automatically reconfigure without human intervention in case of broken links. Automated network analysis through link and route discovery and evaluations are the distinguishing features of self-healing network algorithms. Through discovery, networks establish one or more routes between the originator and the destination. Through evaluation, networks detect route failures, trigger renewed discovery, and in some cases select the best route available for a message. Because discovery and route evaluation consume network capacity so these two must be used carefully to achieve good network performance.

B) SELF HEALING IN ENERGY EFFICIENCY

As the network is always on, conserving energy is more difficult. One solution is On-demand discovery **[**12**].** It establishes only the routes that are requested by higher-layer software. On-demand discovery networks are only "on" when called for. This allows nodes to conserve energy and bandwidth and keeps the network fairly free of traffic. Once routes have been established, they must generally be maintained in the presence of failing equipment, changing environmental conditions, interference, etc. This maintenance may also be proactive or on-demand. Another solution can be Single-path routing [12**].** As for routing, network algorithms that choose single-path routing, single out a specific route for a given source-destination pair.

2.0 SELF HEALING NETWORK

In developing broadband digital networks, a short service-outage such as a link failure or a node failure can cause a serious impairment of network services. It is due to the volume of network traffic carried by a single link or node. Moreover, the outage can stimulate end users to try to re-establish their connections within a short time. The retrials, however, make the problem worse because the connection establishment increases the traffic volume further. Fast restoration from a network failure becomes a critical issue in deploying high-speed networks. Self healing algorithms have been recognized as a major mechanism for providing the fast restoration. A self-healing system [6] should recover from the abnormal state and return to the normal state, and should start functioning as it was prior to failure. One of the key issues associated with self-healing networks is to optimize the networks while expecting reasonable network failures [6,7,8]. Self-healing network (SHN) [9] is designed to support transmission of messages across multiple nodes while also protecting against recursive node and process failures. It will automatically recover itself after a failure occurs. The problem of self-healing is in networks that are reconfigurable in the sense that they can change their topology during an attack. One goal is to maintain connectivity in these networks, even in the presence of repeated adversarial node deletion. Modern computer systems are approaching scales of billions of components. Such systems are less akin to a traditional engineering enterprise such as a bridge, and more akin to a living organism in terms of complexity. A railway overbridge must be designed in such a way that, key components never fail, since there is no way for the bridge to automatically recover from system failure. In contrast, a living organism cannot be designed so that no component ever fails: there are simply too many components. For example, skin can be cut and still heal. Designing skin that can heal is much more practical than designing skin that is completely rigid to attack. Unfortunately, current algorithms ensure robustness in computer networks through hardening individual components or, at best, adding lots of redundant components [10]. Critical issues [11] in self-healing systems typically include; Maintenance of system health, recovery processes to return the state from an unhealthy state to a health one. Self-healing components or systems typically have the following characteristics [11]: (a) perform the productive operations of the system, (b) coordinate the activities of the different agents, (c) control and audit performance, (d) adapt to external and internal changes and (e) have policies to determine the overall purpose of the system. Most of the self-healing concepts are still in very early stages; still some possible areas explored are Grid computing, software agents, middleware computing, ad hoc networks. Emphasis here is on ad hoc network self healing characteristic. This section provides an analysis of various schemes that can be used as self healing schemes.

A) SELF HEALING IN ROUTING

The most promising developments in the area of self-healing wireless networks are ad hoc networks. They are decentralized, self-organizing, and automatically reconfigure without human intervention in the event of degraded or broken communication links between transceivers. Automated network analysis through link and route discovery and evaluation are the distinguishing features of self-healing network algorithms. Through discovery, networks establish one or more routes between the originator and the recipient of a message. Through evaluation, networks detect route failures, trigger renewed discovery, and—in some cases—select the best route available for a message. Because discovery and route evaluation consume network capacity, careful use of both processes is important to achieving good network performance.

B) SELF HEALING IN RF

Environmental radio-frequency (RF) [12] "noise" produced by powerful motors, other wireless devices, microwaves—and even the moisture content in the air—can make wireless communication unreliable. Despite early problems in overcoming this pitfall, the newest developments in self-healing wireless networks are solving the problem by capitalizing on the inherent broadcast properties of RF transmission. The changes made to the network architectures are resulting in new methods of application design for this medium.

C) SELF HEALING IN POWER EFFICIENCY

As the network is always on, conserving power is more difficult. One solution is On-demand discovery [11]. It establishes only the routes that are requested by higher-layer software. On-demand discovery networks are only "on" when called for. This allows nodes to conserve power and bandwidth and keeps the network fairly free of traffic. If, between transmissions, the link quality between nodes has degraded, however, on-demand networks can take longer to reconfigure and, thus, to deliver a message. Once routes have been established, they must generally be maintained in the presence of failing equipment, changing environmental conditions, interference, etc. This maintenance may also be proactive or on-demand. Another solution can be Single-path routing [11]. As for routing, network algorithms that choose single-path routing, as the name suggests, single out a specific route for a given source-destination pair. Sometimes, the entire end-to-end route is predetermined. Sometimes, only the next "hop" is known. The advantage of this type of routing is that it cuts down on traffic, bandwidth use, and power use. If only one node at a time needs to receive the packet, others can stop listening after they hear that they're not the recipient.

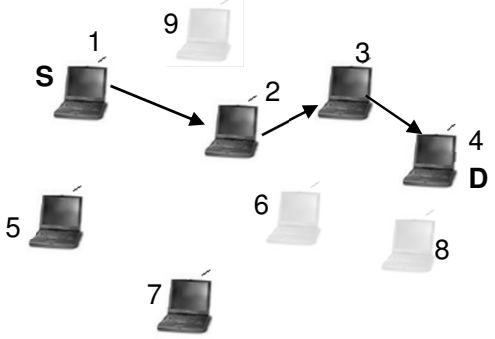
3.0 PROPOSED SCHEME

The proposed protocol helps to increase the stability of route in AODV with avoidance of route break. In this the route stability of the node is measured by following parameters:

1. Node energy
2. Node mobility
3. Traffic load

In this paper a new scheme, known as the Backbone based routing [16, 17] has been suggested which would allow mobile nodes to maintain routes to destinations with more stable route selection. This scheme responds to link breakages and changes in network topology in a timely manner. It uses concept of backbone nodes to participate in route selection, where backbone nodes are neighboring nodes at one hop distance from participating nodes. This makes route maintenance and recovery phase more efficient and fast. These backbone nodes help in reconstruction phase in the fast selection of new routes. Selection of backbone nodes is made upon availability of nodes. Each route table has an entry for number of backbone nodes attached to it. Whenever need for a new route arises in case of route break, check for backbone nodes are made, and a new route is established. Same process is repeated in route repair phase. Route tables are updated at each hello interval as in AODV with added entries for backbone nodes. These are nodes at the one hop distance from its neighbor. Backbone nodes are those nodes which are not participating in route process currently or nodes which enter the range of transmission during routing process. As nodes are in random motion for a scenario, so there is every possibility that some nodes are idle and are in the vicinity of the routing nodes. Whenever a break in the route phase occurs due to movement of participant node, node damage or for other reasons; these idle nodes which have been termed as backbone nodes take care of the process and start routing. The whole process becomes fast and more packet delivery is assured. The changes in the existing protocol are required at route reply and route recovery phases. In these phases the route table is updated with entries of backbone nodes. Each route table has an entry for number of backbone nodes surrounding it and their hop distance form the node. For simplicity of the protocol the distance has been assumed to be one hop. As has been described in Figure 2, the Route selection from S (source) to D (destination) is made via 1-2-3-4 using shortest path routing. In case any of the participating nodes damages or move out of the range, the backbone nodes can be 6, 8 and 9. These nodes are nearer to the routing path nodes and can join the process at any time.

FIGURE 2: ROUTING



4.0 CONCLUSION

In this paper a new scheme has been presented that utilizes alternate paths. The scheme can be incorporated into any ad hoc on-demand unicast routing protocol to heal link failures. It will improve reliable packet delivery even in route breaks. Alternate routes are utilized only when data packets cannot be delivered through the primary route. As a case study, the proposed scheme has been incorporated to AODV and it is expected that the performance improves. Study is going on currently investigating ways to make this new scheme robust to traffic load. The proposed scheme gives a better approach for on demand routing protocols for route selection and maintenance. It is expected that overhead in this protocol will be slightly higher than others, which is due to the reason that it requires more calculations initially for checking backbone nodes. This also may cause a bit more end to end delay. The proposal is to check this scheme for more detailed and realistic channel models with fading and obstacles in the simulation. Efforts are on to simulate the scheme using NS2 and compare results with existing schemes. Self-healing systems are relatively new to both for the academia and the industry. However, hope is to see a large number of systems, software and architectures that borrow from nature, ideas and concepts vary quickly in future. Modeling computer security using biology as a motivation can help in creating adaptive systems that provide functionality despite the possibility of disasters. The obvious goal is to generate a technique that will reveal that Self-healing networks are designed to be robust even in environments where individual links are unreliable, making them ideal for dealing with unexpected circumstances. The dynamic nature that gives these networks their self-healing properties, however, also makes them difficult to test. Even after multiple deployments and thorough simulation, it's difficult to predict how these systems will work (or fail) in actual emergencies. Though the best use for technologies are often difficult to predict, still one can almost certain that the self-healing networks is waiting to be developed and getting popular.

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