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Spatial Reusability-Aware Routing in Multi-Hop Wireless Networks

T. Sree Lakshmi[#1] and Sunku Umamahaheswari[*2]

[#] *M.Tech (CSE),PG Scholar ,Department of Computer Science & Engineering, KORM College of Engineering, Kadapa, India*

[*] *Associate Professor , Department of Computer Science & Engineering, KORM College of Engineering, Kadapa, India*

***Abstract*— The problem of routing in multi-hop wireless networks, to achieve high end-to-end throughput, it is difficult to find the optimal path from the source node to the destination node. Although a large number of routing protocols have been implemented to find the path with minimum transmission time for sending a single packet, such transmission time reduces protocols cannot be guaranteed to achieve high end-to-end throughput. Spatial reusability aware routing in multi hop wireless network is featured by considering spatial reusability of the wireless communication media. Spatial reusability-aware single-path routesand anypath routing protocols, and compare them with existing single-path routing and anypath routing protocols, respectively. Our evaluation results show that our protocols significantly improve the end-to-end throughput compared with existing protocols.**

***Index Terms*— Underwater sensor networks, opportunistic routing, delay sensitive, energy cost.**

I. Introduction

Large number of works wireless routing matrices is done in traditional wireless sensor network. In wireless communication network it is important to carefully find the high utility route in multi-hop wireless networks, a large number of routing protocols have been proposed for multi hop wireless networks. However, a fundamental problem with existing wireless routing protocols is that minimizing the overall number of transmissions to deliver a single packet from a source node to a destination node does not necessarily maximize the end-to-end throughput. We investigate two kinds of routing protocols, including single-path routing and any path routing. The task of a single-path routing protocol is to select a cost minimizing path, along which the packets are delivered from the source node to the destination node. In spatial reusability of wireless signals fade during propagation, two links are free of interference if they are far away enough, and thus can transmit at the same time on the same channel. To the best of our knowledge, most of the existing routing protocols do not take spatial reusability of the wireless communication. We consider spatial reusability of wireless sensor network routing using spatial reusability of by single path routing and any path routing media into account.Routing protocols are generally implemented based on transmission cost minimizing routing metrics, they cannot guarantee maximum end-to-end throughput when spatial reusability need to be considered. They need centralized control to realize MAC-layer scheduling, and to eliminate transmission contention. The algorithms proposed in this work do not require any scheduling, and the SASR algorithms can be implemented in a distributed manner. Our approach can be extended to adapt to multiple transmission rates, as long as the conflict graph of links can be calculated. Proposed system motivate to simply select the (any) path that minimizes the overall transmission counts or transmission time for delivering a packet.

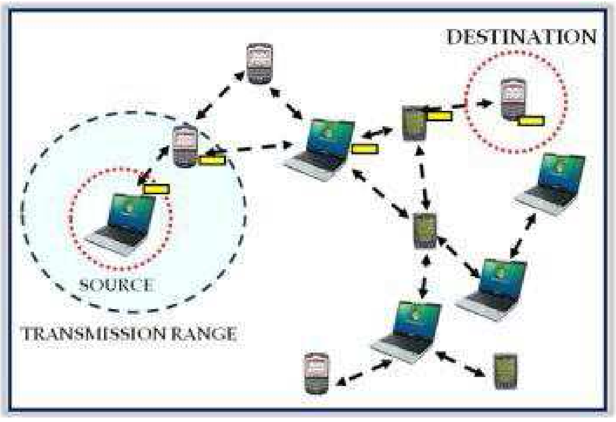

Fig 1: Mobile Ad-hoc Network

A mobile ad-hoc network (MANET) is a wireless communication network that can operate without existing infrastructure and support a number of mobile users. It is one of the general scopes of multi-hop wireless networking. Such networking paradigm originated from the needs in emergency operations, battlefield communications, search and rescue, and disaster relief operations. The main challenges in this area of research include end-to-end data forwarding, communication link access control, network security and providing support for real-time multimedia streaming. Centralized control and management or fixed network infrastructure such as base stations or access points are not essential in ad-hoc networks. Quick and inexpensive set up can be done for it, as needed. A mobile ad-hoc wireless network contains an autonomous group of mobile users that communicate over reasonably slow wireless links. Due to the mobility of nodes, many rapid and unpredictable changes may be done over the time. In such network, the mobile nodes maintain all the network activities like route discovery and message delivery, so that such network is decentralized.

In this paper, we propose a lightweight proactive source routing protocol to facilitate opportunistic data forwarding in MANETs. The information is periodically exchanged among neighbouring nodes for updated network topology information to all other nodes in the network. This allows it to support both source routing and conventional IP forwarding. When doing this, we try to reduce the routing overhead as much as we can. The results of simulation denote that our methodology has only a fraction of overhead of OLSR, DSDV, and DSR but still offers a similar or better data transportation capability compared with these protocols.

II. LITERATURE SURVEY

We present a link layer protocol called the Multi-radio Unification Protocol or MUP. On a single node, MUP coordinates the operation of multiple wireless network cards tuned to non-overlapping frequency channels. The goal of MUP is to optimize local spectrum usage via intelligent channel selection in a multihop wireless network. MUP works with standard-compliant IEEE 802.11 hardware, does not require changes to applications or higher-level protocols, and can be deployed incrementally. The primary usage scenario for MUP is a multihop community wireless mesh network, where cost of the radios and battery consumption are not limiting factors. We describe the design and implementation of MUP, and analyze its performance using both simulations and measurements based on our implementation. Our results show that under dynamic traffic patterns with realistic topologies, MUP significantly improves both TCP throughput and user perceived latency for realistic workloads [1].

From this paper we refer an innovative design for the operation of such ad-hoc networks. The basic idea of the design is to operate each Mobile Host as a specialized router, which periodically advertises its view of the interconnection topology with other Mobile Hosts within the network. This amounts to a new sort of routing protocol. We describe the ways in which the basic network-layer routing can be modified to provide MAC-layer support for ad-hoc networks [2]. An ad hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration so from his paper we refer the results of a detailed packet-level simulation comparing four multi-hop wireless ad hoc network routing protocols that cover a range of design choices: DSDV, TORA, DSR, and AODV. We have extended network simulator to accurately model the MAC and physical-layer behavior of the IEEE 802.11 wireless LAN standard, including a realistic wireless transmission channel model, and present the results of simulationsof networks of 50 mobile nodes [3].

Opportunistic routing is a recent technique that achieves high throughput in the face of lossy wireless links. The current opportunistic routing protocol, ExOR, ties the MAC with routing, imposing a strict schedule on routers' access to the medium. Although the scheduler delivers opportunistic gains, it misses some of the inherent features of the 802.11 MAC. For example, it prevents spatial reuse and thus may underutilize the wireless medium. It also eliminates the layering abstraction, making the protocol less amenable to extensions to alternate traffic types such as multicast [4]. We refer a new protocol for routing in multi-radio, multi-hop wireless networks. Our protocol, Multi-Radio LinkQuality Source Routing, is designed for wireless networks with stationarynodes, where each node is equipped with multiple independent radios[5].

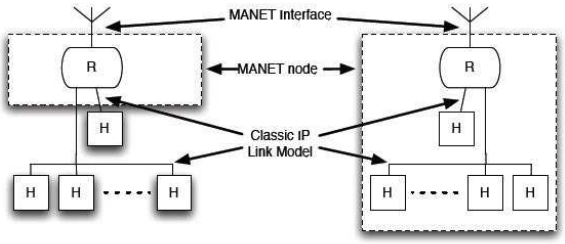

Fig2: MANET node model, R-router, H-host

III. RELATED WORK

PSR proposed by Zehua Wang [2] maintains network topology using spanning tree. It takes the concept of BFS and streamlined differential update. Wang also propose a new concept, known as CORMAN [1], which is a network layer solution to the opportunistic data transfer in mobile ad-hoc networks. CORMAN contains three modules that provide a solution for one of the existing challenges. Routing protocols in MANETs can be categorized using an array of criteria. The most fundamental among these is the timing of routing information exchange. On one hand, a protocol may require that nodes in the network should maintain valid routes to all destinations at all times. In this case, the protocol is considered proactive, which is also known as table driven. Examples of proactive routing protocols include destination sequenced distance vector (DSDV) [8] and OLSR [9].

In a DV, a node only provides its neighbours with the cost to reach each destination. With the estimates coming from neighbours, each node is able to determine which neighbour offers the best route to a given destination. Both LS and DV support the vanilla IP packets. DSR, however, takes a different approach to ondemand source routing. In DSR, a node employs a path search procedure when there is a need to send data to a particular destination. Once a path is identified by the returning search control packets, this entire path is embedded in each data packet to that destination. Thus, intermediate nodes do not even need a forwarding table to transfer these packets. Because of its reactive nature, it is more appropriate for occasional or lightweight data transportation in MANETs. AODV, DSDV, and other DV-based routing algorithms were not designed for source routing; hence, they are not suitable for opportunistic data forwarding. The reason is that every node in these protocols only knows the next hop to reach a given destination node but not the complete path. OLSR and other LS-based routing protocols could support source routing, but their overhead is still fairly high for the load-sensitive MANETs. DSR and its derivations have a long bootstrap delay and are therefore not efficacious for frequent data exchange, particularly when there are a large number of data sources.

IV. EXISTING AND PROPOSED WORK

In An ad hoc network wireless sensor nodes dynamically forming a network without the use of any existing network infrastructure administration. Which limit transmission range of wireless network devices, multiple networks "hops" may be needed for one node to exchange data with another across the network. So existing work proposed, a variety of new routing protocols targeted specifically at this environment have been developed, but little performance information on each protocol and no realistic performance comparison between them is available.

A. Disadvantage of Existing system

1. Energy consumption was bigger challenge to wireless sensor network.
2. In multi hop communication secure data transmission with less cost is ignored.
3. Existing infrastructure is expensive or inconvenient to use, wireless mobile users may still be able to communicate through the formation of an ad hoc network.

In spatial reusability aware routing scheme novel approach is defined withthe spectrum spatial reusability in any path routing, and propose SAAR algorithm for participating node selection, cost calculation, and forwarding list determination. We have designed SASR algorithms and SAAR algorithm with different data rates in network simulator. The evaluation results show that our algorithms works improvement to end-to-end throughput compared with existing
Ones

B. Advantage of Proposed System

1. Reduced energy consumption in WSN.
2. Secure node to node communication.
3. Reduce packet drop attack with trust based active source routing.

V. METHODOLOGY

Due to its proactive nature, the update operation of PSR is iterative and distributed among all nodes in the network. At the beginning, node v is only aware of the existence of itself; therefore, there is only a single node in its PSR, which is root node v. By exchanging the PSRs with the neighbors, it is able to construct a PSR within N[v].In each subsequent iteration, nodes exchange their spanning trees with their neighbors. From the perspective of node v, toward the end of each operation interval, it has received a set of routing messages from its neighbors packaging the PSRs. Note that, in fact, more nodes may be situated within the transmission range of v, but their periodic updates were not received by v due to, for example, bad channel conditions. Node v incorporates the most recent information from each neighbor to update its own PSR. It then broadcasts this tree to its neighbors at the end of the period. Formally, v has received the PSRs from some of its neighbors. Node v constructs a union graph.

$$G_v = S_v \cup \bigcup_{u \epsilon N(v)} (T_u - v) \qquad (1)$$

Assume that the network diameter, i.e., the maximum pair wise distance, is D hops. After D iterations of operation, each node in the network has constructed a BFST of the entire network rooted at itself since nodes are timer driven and, thus, synchronized. This information can be used for any source routing protocol. When a neighbor is deemed lost, its contribution to the network connectivity should be removed, this process is called neighbor trimming. Consider node v the neighbor trimming procedure is triggered at v about neighbor u either by the following cases:

1) No routing update or data packet has been received from this neighbor for a given period of time.

2) A data transmission to node u has failed, as reported by the link layer.

Node v responds by:

1) First, updating N(v) with N(v) − {u};

2) Then, constructing the union graph with the information of u removed, i.e.

$$G_v = S_v \cup \bigcup_{w \epsilon N(v)} (T_w - v) \qquad (2)$$

3) Finally, computing BFST.

With this updated BFST at v, it is able to avoid sending data packets via lost neighbors. Thus, multiple neighbor trimming procedures may be triggered within one period.

Consider node v and its BFST Tv. When it receives an update from neighbor u, which is denoted Tu, it first removes the subtree of Tv rooted at u. Then, it incorporates the edges of Tu for a new BFST. Note that the BFST of (Tv − u) Tu may not contain all necessary edges for v to reach every other node. Therefore, we still need to construct union graph

$$(T - u)_v \cup \bigcup_{w \epsilon N(v)} (T_w - v) \qquad (3)$$

before calculating its BFST. To minimize the alteration to the tree, we add one edge of Tw − v to Tv − u at a time. When node v thinks that a neighbor u is lost, it deletes edge (u, v). When a node should share its updated route information with its neighbors, a delay is selected it until the end of the cycle so that only one update is broadcast in each period. If a node were to transmit it immediately when there is any change to its routing tree, it would trigger an explosive chain reaction and the network would be overwhelmed by the route updates.

Due to the dynamic topology, node consumes more energy while roaming. For this, the topology control approach has been introduced. In this approach, we have considered two cases,

1. Energy consumption of the node and routes.
2. Link stability and location stability

In first case, the dynamic and adaptive topology is proposed. It will adopt, according to the node moves with in the network. The number of links connected to a node is very kept low. The link with the low transmission power is also taken in to the consideration for the energy consumption of the route. For link stability and location stability, each node carrying link with highest density and efficient transmission power with adaptable location. The location stability which implies node is on the stable state which is ready state to send the number of packets to the intended destination node with degrading the network performance. While implementing these two cases, the energy consumption of the whole network can be effectively reduced.

VI. PERFORMANCE EVALUATION

We study the performance of PSR using computer simulation with Network Simulator 2 version 2.34 (ns-2). We compare PSR against OLSR [7], DSDV [9], and DSR [8], which are three fundamentally different routing protocols in MANETs, with varying network densities and node mobility rates. We measure the data transportation capacity of these protocols supporting the Transmission Control Protocol (TCP) and the WANG et al.: PSR 863 User Datagram Protocol (UDP) with different data flow deployment characteristics. Our tests show that the overhead of PSR is indeed only a fraction of that of the baseline protocols. Nevertheless, as it provides global routing information at such a small cost, PSR offers similar or even better data delivery performance. Here, we first describe how the experiment scenarios are configured and what measurements are collected. Then, we present and interpret the data collected from networks with heavy TCP flows and from those with light UDP streams.

A. TCP With Node Density

We first study the performance of PSR, OLSR, DSDV, and DSR in supporting 20 TCP flows in networks with different node densities. Specifically, with the default 250-m transmission range in ns-2, we deploy our 50-node network in a square space of varying side lengths that yield node densities of approximately 5, 6, 7, . . . , 12 neighbors per node. These nodes move following the random waypoint model with vmax = 30 m/s.

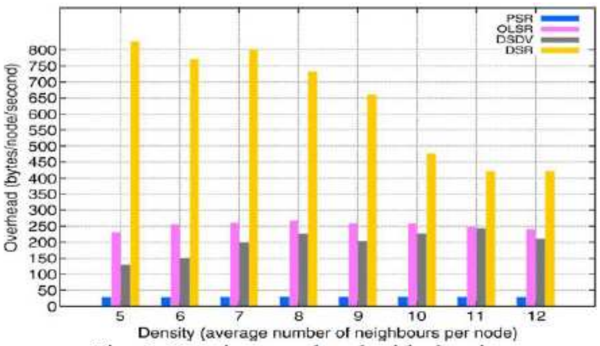

Fig. 2. Routing overhead with density

We plot in Fig. 2 the per-node per-second routing overhead, i.e., the amount of routing information transmitted by the routing agents measured in B/node/s, of the four protocols when they transport a large number of TCP flows. This figure shows that the overhead of PSR (20 to 30) is just a fraction of that of OLSR and DSDV (140 to 260) and more than an order of magnitude smaller than DSR (420 to 830). The routing overhead of PSR, OLSR, and DSDV goes up gradually as the node density increases. This is a typical behavior of proactive routing protocols in MANETs. These protocols usually use a fixed-time interval to schedule route exchanges. While the number of routing messages transmitted in the network is always constant for a given network, the size of such message is determined by the node density. That is, a node periodically transmits a message to summarize changes as nodes have come into or gone out of its range. As a result, when the node density is higher, a longer update message is transmitted even if the rate of node motion velocity is the same. Note that when the node density is really high, e.g., around 10 and 12, the overhead of OLSR flattens out or even slightly decreases. This is a feature of OLSR when its multipoint relaying mechanism becomes more effective in removing duplicate broadcasts, which is the most important improvement of OLSR over conventional LS routing protocols. PSR uses a highly concise design of messaging, allowing it to have much smaller overhead than the baseline protocols. In contrast, DSR, as a reactive routing protocol, incurs significantly higher overhead when transporting a large number of TCP flows because every source node needs to conduct its own route search. This is not surprising as reactive routing protocols were not meant to be used in such scenarios. The test against all four protocols supporting only a few UDP streams for a different perspective.

B. TCP With Velocity

Study on the performance of PSR and compare it to OLSR, DSDV, and DSR with different rates of node velocity. In particular conduct another series of tests in networks of 50 nodes deployed in a 1100 × 1100 (m2) square area with vmax set to 0, 4, 8, 12, . . . , 32 (m/s). The network thus has an effective node density of around seven neighbours per node, i.e., a medium density among those configured earlier.

As with before, 20 TCP one-way flows are deployed between 40 nodes, and we measure the routing overhead, TCP throughput, and end-to-end delay.

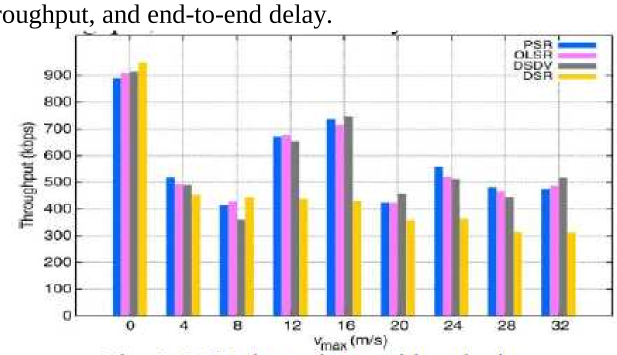

Fig. 3. TCP throughput with velocity

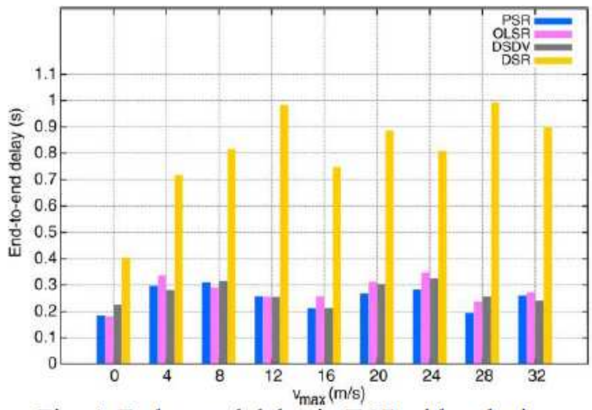

Fig. 4. End-to-end delay in TCP with velocity.

VII. CONCLUSION

We are the first to explicitly consider spatial reusability of the wireless communication media in routing, and design practical spatial reusability-aware single-path routing and any path routing protocols. We define the problem of spatial reusability aware single-path routing, and propose two complementary categories of algorithms for path selection.

While one category leads to implement the best solution paths, the other way evaluates the performance of the paths in the critical case. Active source routing protocol is used for efficient energy management with multipath routing. Network node authentication for intrusion detection in wireless network communication. Proposed system design opportunities routing to improve the performance of our routing algorithms by analyzing special attacking cases identified in the routing. Another direction is to implement inter-flow spatial reusability, and to optimize system network performance. Spatial reusability aware routing can efficiently improve the source to destination communication with high end throughput in multi-hop wireless networks, by carefully considering spatial reusability of the wireless communication media. This is done by the protocols, SASR and SAAR, for spatial reusability-aware single-path routing and any path routing, respectively. To contribute more for better energy efficiency system implement opportunistic routing to reduce energy consumption.

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