A Cooperative Approach for Opportunistic Routing In Mobile Ad Hoc Networks

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Abstract— Cooperative Communication, a new research area, has revealed a recent origin in the wireless networks, which combines the link-quality and the broadcasting nature of the wireless channels. It is a pure network layer scheme that can be built on top of the wireless networking equipment. Nodes in the network use a lightweight proactive source routing protocol to determine a list of intermediate nodes that the data packets should follow en route to the destination. Here, when a data packet is broadcast by an upstream node and received by a downstream node further along the route, it continues its way from there and thus will arrive at the destination node sooner. This is achieved through cooperative data communication at the link and network layers. The CORMAN protocol was used for the purpose of cooperative communication, is implemented and observed significant performance improvement in varying mobile settings.

Keywords – Opportunistic routing; Cooperative communication; Proactive source routing; Live Update; Retransmission;

I. INTRODUCTION

Wireless Ad hoc network consists of self-organizing devices and can be deployed without infrastructure. Mobile Ad hoc Networks (MANETs) can be defined as autonomous system of mobile nodes connected via wireless links without using any existing network infrastructure. Each node acts as a host as well as a router and forwards each others' packets to enable the communication between nodes not directly connected by wireless links. An example of MANET is given in Figure 1. A central challenge in the design of ad hoc networks is the development of dynamic routing protocols that can efficiently find routes between the communicating nodes. The routing protocol must be able to keep up with the high degree of node mobility that often changes the network topology drastically and unpredictably. The combination of link-quality variation with the broadcasting nature of Wireless channels has revealed a direction in the research of wireless networking, namely, cooperative communication.

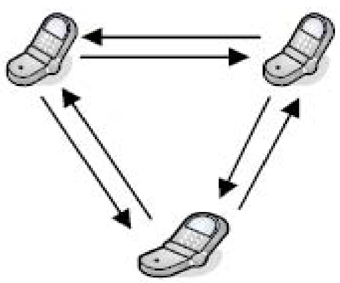

Figure 1. Example of MANET

The mainstay of the paper is to propose and solve the problem of opportunistic data transfer in mobile ad hoc networks. Research on cooperative communication started to attract interests in the community at the physical layer but more recently its importance and usability have also been realized at upper layers of the Network protocol stack. It is a pure network layer scheme that can be built atop off-the-shelf wireless networking equipment. Nodes in the network use a lightweight proactive source routing protocol to determine a list of intermediate nodes that the data packets should follow en route to the destination. Here, when a data packet is broadcast by an upstream node and has happened to be received by a downstream node further along the route, it continues its way from there and thus will arrive at the destination node sooner. This is achieved through cooperative data communication at the link and network layers. This work is a powerful extension to the pioneering work of ExOR. A new routing protocol for Cooperative transmission among Mobile Ad Hoc Networks called CORMAN [1] is implemented and observed significant performance improvement in varying mobile settings.

II. RELATED WORK

Biswas. S and R. Morris [2], introduces ExOR, an integrated routing and MAC protocol that increases the throughput of large unicast transfers in multi-hop wireless networks. ExOR chooses each hop of a packet's route after the transmission for that hop, so that the choice can react with intermediate nodes actually received the transmission. This deferred choice gives each transmission multiple opportunities to make progress. ExOR's design faces the following challenges. The nodes that receive each packet must agree on their identities and choose one forwarder. The agreement protocol must have low overhead, but must also be robust enough that it rarely forwards a packet zero times or more than once. Finally, ExOR must choose the forwarder with the lowest remaining cost to the ultimate destination. Measurements of an implementation on a 38-node 802.11b test-bed show that ExOR increases throughput for most node pairs when compared with traditional routing.

Chachulski S et al [3], discusses about Opportunistic routing which 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. This paper presents MORE, a MAC-independent opportunistic routing protocol. MORE randomly mixes packets before forwarding them. This randomness ensures that routers that hear the same transmission do not forward the same packets. Thus, MORE needs no special scheduler to coordinate routers and can run directly on top of 802.11. MORE protocol is implemented in the Click modular router running on off-the-shelf PCs equipped with 802.11 (WiFi) wireless interfaces. Experimental results from a 20-node wireless testbed show that MORE's median unicast throughput is 20% higher than ExOR, and the gains rise to 50% over ExOR when there is a chance of spatial reuse.

Chlamtac. I et al [4], describes about, a mobile ad hoc network (MANET), sometimes called a mobile mesh network, is a self-configuring network of mobile devices connected by wireless links. The Ad hoc networks are a new wireless networking paradigm for mobile hosts. Unlike traditional mobile wireless networks, ad hoc networks do not rely on any fixed infrastructure. Instead, hosts rely on each other to keep the network connected. Recently, the introduction of new technologies such as the Bluetooth, IEEE 802.11 and Hyperlan are helping enable eventual commercial MANET deployments outside the military domain. These recent evolutions have been generating a renewed and growing interest in the research and development of MANET. This paper attempts to provide a comprehensive overview of this dynamic field.

C. Fragouli et al [5], in their paper said about network coding. Network coding is a new research area that may have interesting applications in practical networking systems. With network coding, intermediate nodes may send out packets that are linear combinations of previously received information. There are two main benefits of this approach: potential throughput improvements and a high degree of robustness. This paper is an instant primer on network coding: It explains what network coding does and how it does it. It includes the discussion about the implications of theoretical results on network coding for realistic settings and shows how network coding can be used in practice.

Rajaraman. R [6], describes about**,** an ad hoc wireless network, or simply an ad hoc network, consists of a collection of geographically distributed nodes that communicate with one other over a wireless medium. A classic example of ad hoc networking is network of war fighters and their mobile platforms in battlefields. Indeed, a wealth of early research in the area involved the development of packet-radio networks (PRNs) and survivable radio networks. While military applications still dominate the research needs in ad hoc networking, the recent rapid advent of mobile telephony and plethora of personal digital assistants has brought to the fore a number of potential commercial applications of ad hoc networks. Examples are disaster relief, conferencing, home networking, sensor networks, personal area networks, and embedded computing applications.

The rest of the paper is organized in the following manner. The Third section describes the Architecture of the proposed cooperative communication system. The Fourth section describes the modules identified for the implementation. The Fifth section describes the outcome of the implementation. Section Six concludes the work and the references used for the work are presented.

III. ARCHITECTURE DIAGRAM OF THE COOPERATIVE COMMUNICATION

Existing System use different routing scheme to find shortest path but that is not depend on path length. So data transfers on source to destination, packets are missed and take delay to receive the data. Onion routing [7] is that to actually provide anonymity the path length between the source and the destination has to be artificially inflated. Each communication passes through several intermediate hops which is less efficient in terms of latency and bandwidth than a direct connection.

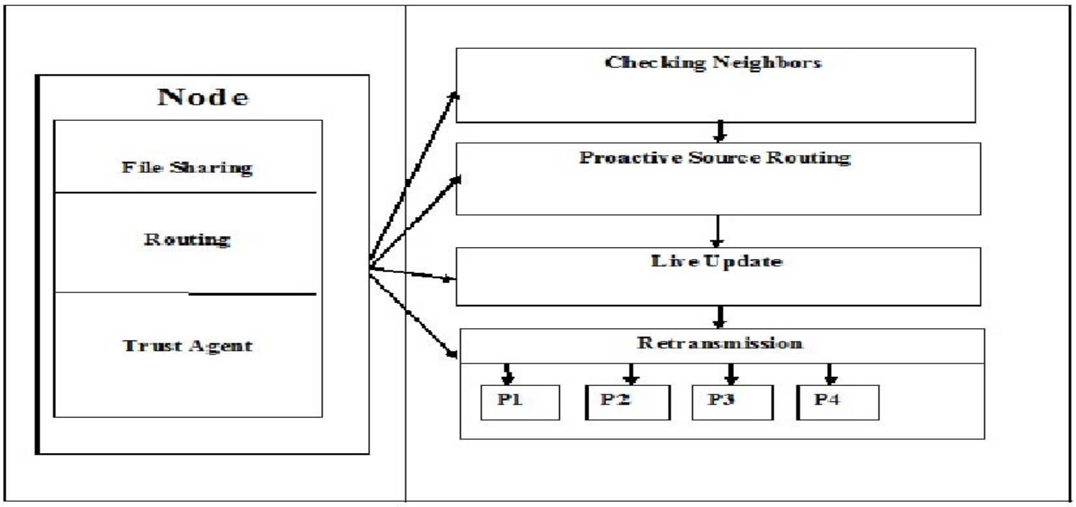

Figure 2. Architecture diagram of Cooperative communication

In the proposed system, (Figure 2) a Forwarder node info is created, to know about all nodes information. It acts like server in traditional networks. From this Forwarder node info all Nodes are gets their neighbor information and from the neighbor list provided by the forwarder node, the Nodes find their destination as well as the shortest path to it. The sequence diagram about the Forwarder node info is given in Figure 3. Shortest path to the destination in order to forward the data can be found by using the Proactive source routing[8] algorithm. The original path to the destination will be provided to the source at the beginning. If any path shorter than the original path is discovered, update that path to all the neighbors and transfer the data with that path. During data transfer if the packet gets lost, then no need to transfer the data again from the beginning, it's just enough to retransfer the data from last node. This retransmission reduces the delay of data transfer among the mobile nodes.

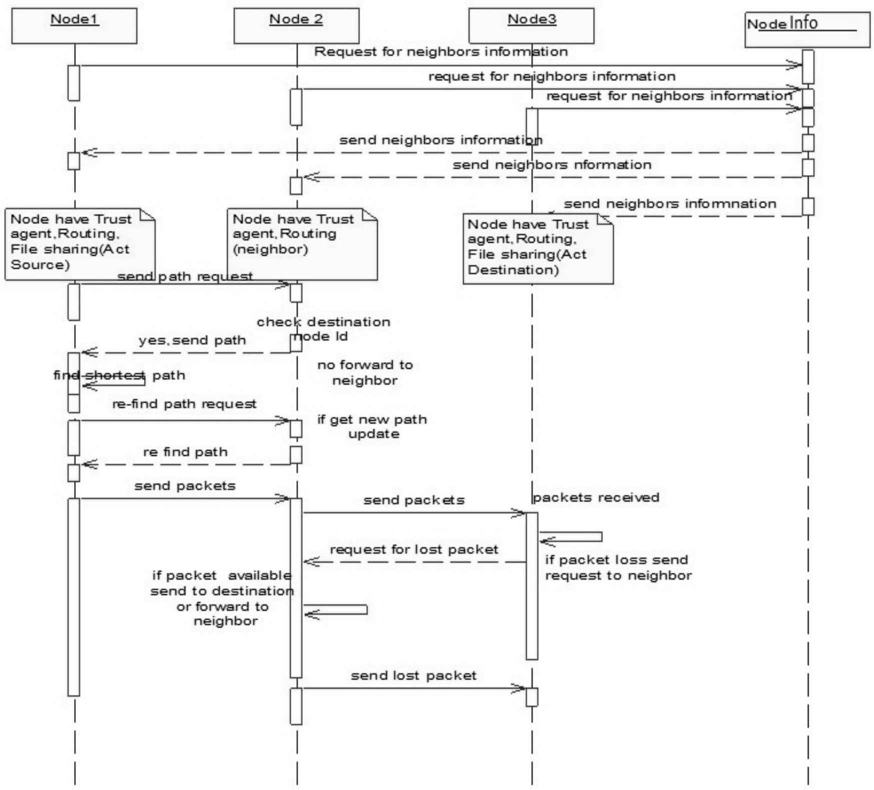

Figure 3. Sequence Diagram about the Forwarder Node info to all the neighbors

IV. IMPLEMENTATION OF COOPERATIVE COMMUNICATION AMONG MOBILE NODES

The following steps are used in this paper for the implementation, they are:

Step 1: Forwarder list info and Neighbor list creation

Step 2: Proactive Source routing

Step 3: Live Update

Step 4: Retransmission

Step1: Forwarder list info and Neighbor list creation

A node called “Forwarder node info” which invokes to create a list called neighbor list. The neighbor list holds all nodes information like distance, node id, tiers etc. From the neighbor list each source node(s) get their destinations node id and other details for the data transfer.

Step 2: Proactive Source Routing (PSR)

PSR, a routing protocol,[8] runs in the background so that nodes periodically exchange network information. PSR is inspired by path finding and link-vector algorithms but is lighter weight. The source node gets the destination list by which the shortest path route will be evaluated with their neighbor nodes list. In that neighbor list searching for the destination will be taking place. If the information about the destination is not available means forward to that neighbor node, from which the searching for the destination happens. The process will be repeated till a shortest path to the destination become available. [9]

Step 3: Live Update

When data packets are received by and stored at a forwarding node [9] , the node may have a different view of how to forward them to the destination from the forwarder list carried by the packets. Since this node is closer to the destination than the source node, such discrepancy usually means that the forwarding node has more updated routing information. In this case, the forwarding node updates the part of the forwarder list in the packets from this point on towards the destination according to its own knowledge. When the packets with this updated forwarder list are broadcast by the forwarder, the update about the network topology change propagates back to its upstream neighbor. The neighbor incorporates the change to the packets in its cache. When these cached packets are broadcast later, the update is further propagated towards the source node. Such an update procedure is significantly faster than the rate at which a proactive routing protocol disseminates routing information.

Step 4: Retransmission

A short forwarder list forces packets to be forwarded over long and possibly weak links. In case a packet of message missed mean we retransmit the packet from last sending node not from the source, due to that packet delay was reduced.

The advantages of the proposed system:

- Proactive Source Routing protocol, a lightweight protocol, runs in the background so that nodes periodically exchange network structure information.
- The source node gets the destination list by which the shortest path route will be evaluated with their neighbor nodes list.

V. OUTPUT

The work has been implemented using the following system requirements: Windows XP, C# .Net (WPF)

Figure 4 shows the login screen for identifying the neighbor nodes. The node gets the neighbors details by using the “distance” parameter. Once the number of hops (distance) is given, the options for file sharing, routing and trust agent are used for the data transfer. After getting the node distance, each node identifies its neighbor.

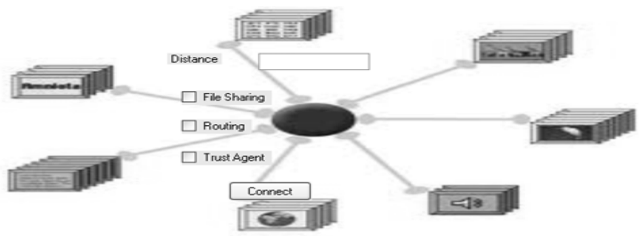

Figure 4. Login screen for a node to form the network

The nodes that are nearby to the source are listed in the Neighbor list info. From this, the neighbor nodes that are attached to the source node are viewed. These nodes form together in an adhoc fashion. The option LoadDestinationNode will list the possible nodes available in the network. The source node which has data to transfer will find the path using “FindPath” option. PSR protocol running in the background will find the possible routes to the destination, in Figure 5.

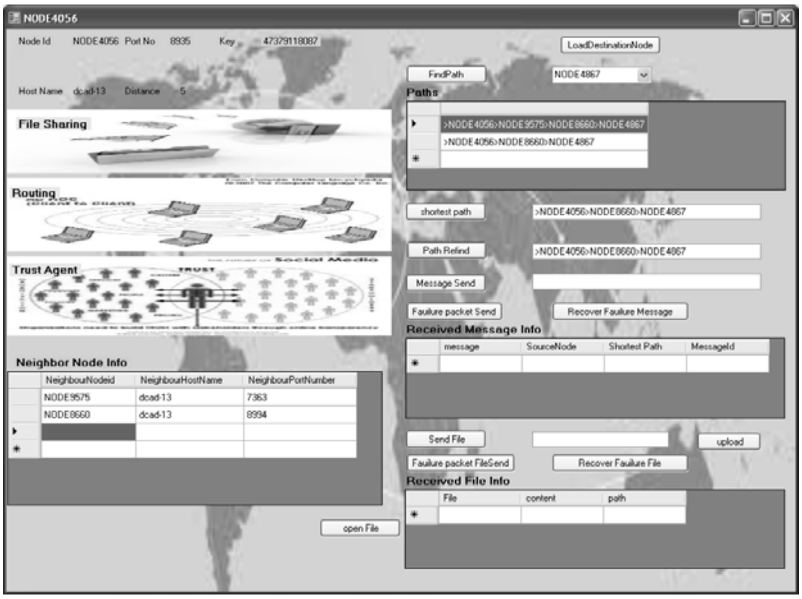

Figure 5. Neighbor list info screen

To transfer the data through the shortest path, the option “shortest path” can be used. If any shortest path available between the source node and the destination node, it will be displayed in the “shortest path” text[8]. Once the shortest path is used, the “path refined” option can be used to reframe the path. In other words, the shortest path, which was identified, will be used for data transmission, thereby reducing the delay.

VI. CONCLUSION

In this paper, a secure cooperative communication is proposed, so that any number of mobile nodes can communicate in wireless mobile ad-hoc network using the Proactive Source Routing (PSR) concept by identifying the all possible paths and transmits the data in shortest path.

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