Experimental Analysis of JODR in MANET using NS2 Simulator

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ABSTRACT

In this paper, we presented a distributed joint transmission rate, link power and average delay control algorithm, in which explicit broadcast message passing is required for power allocation algorithm. Motivated by the desire of power control devoid of message passing, we give a near-optimal power-allocation scheme that makes use of autonomous SINR measurements at each link and enjoys a fast convergence rate. The proposed algorithm is shown through numerical simulations to outperform other network utility maximization algorithms without rate outage probability/average delay constraints, leading to a higher effective rate, lower power consumption and delay. Furthermore, we conduct extensive network-wide simulations in NS-2 simulator to evaluate the performance of the algorithm in terms of throughput, delay, packet delivery ratio and fairness.

Keywords: JODR, MANET, lossy, mobile, network.

1. INTRODUCTION

Mobile Ad-hoc Network (MANET) is a self-configured network of mobile terminals connected by wireless links. Mobile terminals such as cell phones, portable gaming devices, personal digital assistants, (PDAs) and tablets all have wireless networking capabilities. By participating in MANETs, these terminals may reach the Internet when they are not in the range of Wi-Fi access points or cellular base stations, or communicate with each other when no networking infrastructure is available. MANETs can also be utilized in the disaster rescue and recovery. One primary issue with continuous participation in MANETs is the network lifetime, because the aforementioned wireless terminals are battery powered, and energy is a scarce resource. Cooperative communication (CC) is a promising technique for conserving the energy consumption in MANETs. The broadcast nature of the wireless medium (the so-called wireless broadcast advantage) is exploited in cooperative fashion.

A distributed CMAC protocol has been proposed to improve the lifetime of wireless sensor networks, but it is based on the assumption that every node can connect to the base station within one hop, which is impractical for most applications [1,3].

Overview of Ad Hoc Networks

There are two types of wireless mobile networks at present. These networks can be categorized into two architecture classes with different operation mechanisms and related issues. One type is *infrastructured* wireless networks, in which there are fixed wireless gateways that connect the mobile systems with a wired network. Typical applications of such networks are the cellular phone networks and the wireless local area networks (WLANs). The gateways in the cellular phone systems are known as base stations, and the infrastructure in a WLAN are called the access points (APs). The networks with infrastructure are suitable for locations where base stations are present or can be easily placed. An advantage of this type of networks is that the existing wired networks can be employed to support access from mobile users without modifications to the networks' control structure. A disadvantage of these networks is that the fixed infrastructure would constrain node mobility, limit network deploy ability, and increase installation and management costs of the networks.

In a place where infrastructure cannot be placed or not currently available, another type of mobile wireless networks, commonly known as *mobile ad hoc networks* (MANETs), are employed. A MANET consists of a collection of mobile nodes which communicate with each other via wireless links in a self-organized way without fixed network infrastructure and any centralized administration. Nodes in an ad hoc network operate equally and are free to move randomly. Therefore, the network topology may change rapidly and unpredictably. As each individual node in the network has limited wireless transmission range, all network activities, such as discovering network topology and delivering data packets, have to be executed by the nodes themselves individually and/or collectively. Each node needs to act as a router to forward control and data packets for other nodes. Depending on its application, the structure of an ad hoc network may vary from a highly power-constrained small static network, which is as the case for a sensor network, to a large-scale highly dynamic network.

There are generally two types of MANETs: *closed* and *open* [2]. In a closed MANET, all mobile nodes cooperate with each other toward a common goal, such as emergency search/rescue or military and law enforcement operations. In an open MANET, different mobile nodes with different goals share their resources in order to ensure global connectivity. No matter which type of MANETs is used, an ad hoc network can work properly only if the participating nodes cooperate in a proper way.

The ad hoc networks have been studied in the past in to the context of defense, often under the name of packet radio networks. Recently there has been a renewed interest in this field due to the availability of low-cost laptops and palmtops with radio interfaces. A MANET working group [58] has been formed within the Internet Engineering Task Force (IETF) to develop a framework for ad hoc networks. Some examples of possible applications of ad hoc networks include mobile computer users gathering for a conference, emergency disaster relief personnel coordinating efforts, personal area network (PAN) with wireless devices that are closely associated with a single person and interactions between several PANs when people meet, wireless sensor networks in certain dangerous area, and soldiers relaying information for situational awareness on the battlefield [5].

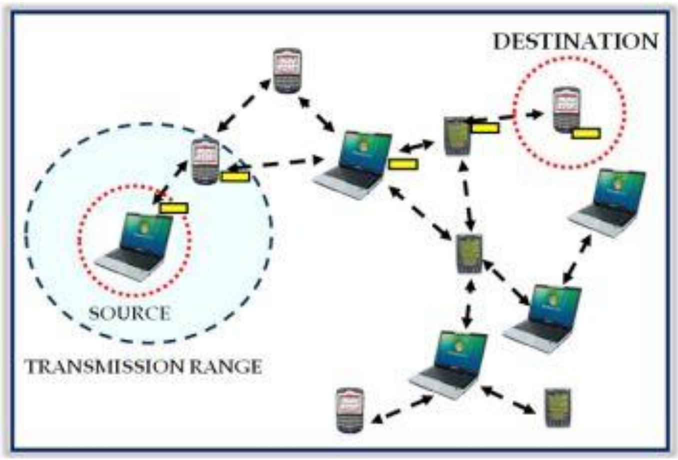

Figure 1: mobile ad hoc network

DEVELOPMENT TOOLS AND TECHNOLOGY

Proposed Method

In this paper we propose probabilistic rebroadcast method which combines both neighbor coverage and probabilistic methods. We consider lossy mobile ad hoc networks where the data rate of a given flow becomes lower and lower along its routing path. Furthermore, we conduct extensive network-wide simulations in NS-2 simulator to evaluate the performance of the algorithm in terms of throughput, delay, packet delivery ratio and fairness.

NCPR (Neighbor Coverage Based Probabilistic Routing Protocol)

The main aim of probabilistic rebroadcast protocol based on neighbor coverage is to reduce the routing overhead and improve the routing performance in MANETs. This approach combines the advantage of probabilistic method and neighbor knowledge method which can solve the broadcast storm problem. Algorithm of NCPR Assumptions: Ai is intermediate node, s is Source node, E(s) is the neighbour set of node s, RREQs is the route request packet received from node s, Rs.id is unique identifier of route request, U(s,i) is Uncovered Neighbour Set of node s for RREQ whose id is i and Timer(s,i) is timer of node s whose id is i. In NCPR Protocol, when source node sends different RREQ need uncovered neighbour set and Timer.

Step 1: If Ai received new RREQs from s then
Step 2: Calculate initial uncovered neighbour set U(Ai, Rs.ID) for RREQs
Step 3: Compute the Rebroadcast Delay i.e. Td(Ai)
Step 4: Set a Timer (Ai, Rs.ID) according to T(Ai)

Step 5: end if
Step 6: if Ni received new RREQs from S then repeat from step 2 to step 4
Step 7: While Ai receives a duplicate RREQm from node Am before Timer (Ai, Rs.ID) expires do…
Step 8: Adjust U (Ai, Rs.ID)
Step 9: Discard (RREQm)
Step 10: Repeat step 7 to 9 until Timer expired
Step 11: end while other node received a duplicate RREQ message repeat step 7 to 9
Step 12: If Timer (Ai, Rs.ID) expires then
Step 13: calculate Rebroadcast Probability P(Ai)
Step 14: Check random probability <=P(Ai)
Step 15: If Yes Broadcast (RREQs)
Step 16: Else Discard (RREQs)
Step 17: Repeat until it reach to Destination.

When source node send RREQ packet to intermediate node it check whether it receive RREQ packet first time then calculate initial UCN set i.e Uncovered neighbor set by comparing neighbor list of itself with previous node neighbor list. After that calculate rebroadcast delay to determine forwarding order, set timer according to rebroadcast delay. Due to characteristics of broadcasting RREQ packet node can receive the duplicate RREQ packet from its neighbor node could adjust the uncovered neighbor set until timer expired.

As time expired with the help of finial UCN set it calculates rebroadcast probability by multiplying the additional coverage ratio and connectivity factor. This rebroadcast probability decide whether to rebroadcast the packet or not. As compare to flooding NCPR protocol generate less redundant rebroadcast and because of this protocol mitigates the network collision and contention, so as to decrease the average end to end delay and increase packet delivery ratio. Although the protocol increases the RREQ packet size, it reduces the number of RREQ packet more significantly.

Probabilistic Broadcasting Based on Coverage Area and Neighbor Confirmation

This approach combines the advantage of probabilistic and area based method. In probabilistic method depend on predefined fixed probability to determined whether to rebroadcast the packet or not but the problem is that how to set rebroadcast probability. As the values of all nodes are same so it is critical to identify and categorise the node in the various regions and appropriately adjust their rebroadcasting probability. So we can dynamically determine the rebroadcasting probability. By using dynamic probabilistic broadcasting based on coverage area and neighbour confirmation in that coverage area is used to adjust the rebroadcasting probability and by using neighbour confirmation confirm that all neighbour received the broadcast packet if some are not received forward packet to that node and determine the suitable probability.

For this author used three steps to determine or adjust the rebroadcasting probability. Shadowing effect help to reduce number of rebroadcast packet. Each node is choosing different probability according to its distance from the sender. As mobile node are closer to the sender or distance from the sender are less than the retransmission probability are set low and if mobile node are far from the sender than retransmission probability of that node is set high.

It is better for the node that is far away from the sender because it may potentially act as relay node on behalf of node closer to the sender. Based on shadowing effect we determine rebroadcast probability by calculating it coverage ratio and connectivity parameter. As distance between sender and node increase coverage area is also increase. As coverage area is directly proportional to distance from sender to node rebroadcast probability should be consider according to their coverage area. After determining the coverage ratio and adjust rebroadcasting probability we should confirmed that all neighbour should received the RREQ packet. If some of them not received RREQ packet its rebroadcast the packet. For example if n1 has the probability that do not broadcast the packet and n2 is the neighbour node of n1 and n2 not received RREQ packet. So n1 wait for the given amount of time and after the time expire it check if all neighbour received the broadcast packet and found that n2 not received the packet then n1 rebroadcast the packet to n2. Author evaluate the performance of this approach with simple flooding and analysis that the number of node transmit broadcast packet with no mobility and mobility of 20m/s this approach can substantially reduce the number of rebroadcast, reduce the collision packet more than 50% compare with flooding but this approach as more delay time compare with flooding.

Neighbour knowledge scheme name SBA (scalable Broadcast Algorithm)

The main aim of this broadcast algorithm is to reduce unnecessary rebroadcasting by comparing the neighbour list (which is attach with RREQ packet) of current node with previous node. If all neighbour nodes have been received

RREQ packet by previous transmission, node need not rebroadcast a message. In this approach local neighbour discovery and data broadcasting are utilised to avoid unnecessary rebroadcast and reduce overhead in network. In local neighbour hello message are used to collect the neighbour information within 2 hops. When node received broadcast RREQ packet from previous node by checking the neighbour list of that node find which node have been covered by transmission and that node are added in BCS i.e Broadcast coverage set. If all node nodes are covered then rebroadcasting is not necessary and can be cancelled.

In data broadcasting when sender transmit a packet to all neighbour node and when receiver receives the packet first time receiver knows all its neighbour common to sender. It schedule RAD (random Access Delay) for delaying rebroadcast operation and start RAD, until RAD expired it accept the packet. After expired check all node covered or not if not send the packet to that node. This approach reduces the broadcast redundancy efficiently. As compare with flooding SBA reduce routing overhead about 60%, decrease packet delivery ratio of flooding with increase of network size and reduce end to end delay.

DRP (Dynamic Probabilistic Route Discovery)

In fixed Probabilistic based scheme is used in which source node broadcast the packet by using flooding mechanism and every mobile node rebroadcast the packet based on predetermined fixed probability P. The main reason for appropriate adjustment of forwarding probability is varying degree of MANET node density. Every node in MANET has assigned fixed probability of route discovery which lead to unfair distribution in fixed probabilistic approach. Dynamic probability route discovery approach determines the forward probability of RREQ considering set of covered neighbor and local node density of forwarding node which overcome the problem. By using Hello protocol the neighbour information is collected.

The local neighbour information is used to estimate number of node in a particular region. Mobile node send the hello packet to neighbour node it check the entry in neighbor table if it does not have entry it create the entry in table or if neighbour node have the entry in table it update that entry. At certain amount of time if neighbour node is not receive hello packet delete the entry in table because all node in table are active node and thus link between them. When node sending RREQ packet attach with recent neighbour list to intermediate node it search through the list to determine its set of node that have been covered by the broadcast. When large number of neighbour are covered then in that case forwarding probability at a node is set low otherwise set high.

RESULTS AND DISCUSSIONS

NET: The .NET Framework is Microsoft's comprehensive and consistent programming model for building applications that have visually stunning user experiences, seamless and secure communication, and the ability to model a range of business processes. .NET Framework (pronounced dot net) is a software framework developed by Microsoft that runs primarily on Microsoft Windows. It includes a large class library named Framework Class Library (FCL) and provides language interoperability (each language can use code written in other languages) across several programming languages. Programs written for .NET Framework execute in a software environment (in contrast to a hardware environment) named Common Language Runtime (CLR), an application virtual machine that provides services such as security, memory management, and exception handling. (As such, computer code written using .NET Framework is called "managed code".) FCL and CLR together constitute .NET Framework.

FCL provides user interface, data access, database connectivity, cryptography, web application development, numeric algorithms, and network communications. Programmers produce software by combining their source code with .NET Framework and other libraries. The framework is intended to be used by most new applications created for the Windows platform. Microsoft also produces an integrated development environment largely for .NET software called Visual Studio.

.NET Framework began as proprietary software, although the firm worked to standardize the software stack almost immediately, even before its first release. Despite the standardization efforts, developers, mainly those in the free and open-source software communities, expressed their unease with the selected terms and the prospects of any free and open-source implementation, especially regarding software patents. Since then, Microsoft has changed.

.NET Framework led to a family of .NET platforms targeting mobile computing, embedded devices, alternative operating systems, and web browser plug-ins. A reduced version of the framework, .NET Compact Framework, is available on Windows CE platforms, including Windows Mobile devices such as smartphones. .NET Micro Framework is targeted at very resource-constrained embedded devices. Silverlight was available as a web browser plugin. Mono is available for many operating systems and is customized into popular smartphone operating systems (Android and iOS) and game engines. .NET Core targets the Universal Windows Platform (UWP), and cross-platform and cloud computing workloads.

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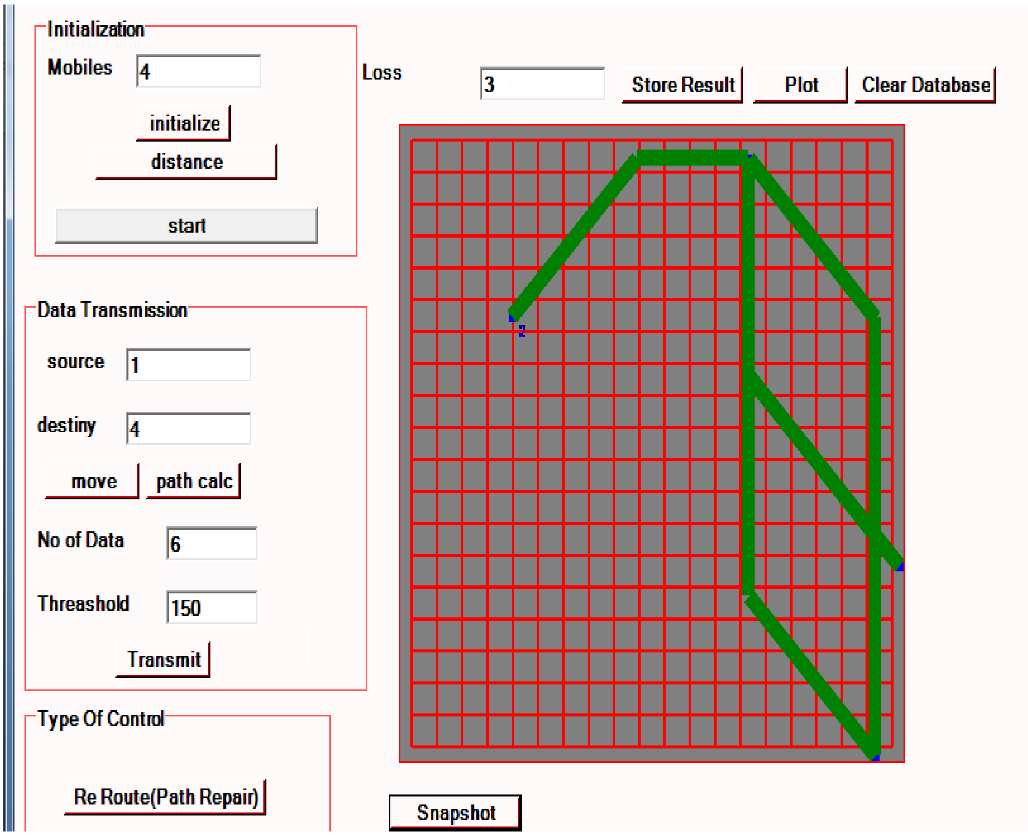

Figure 3: Joint optimal data rate for 4 destiny nodes

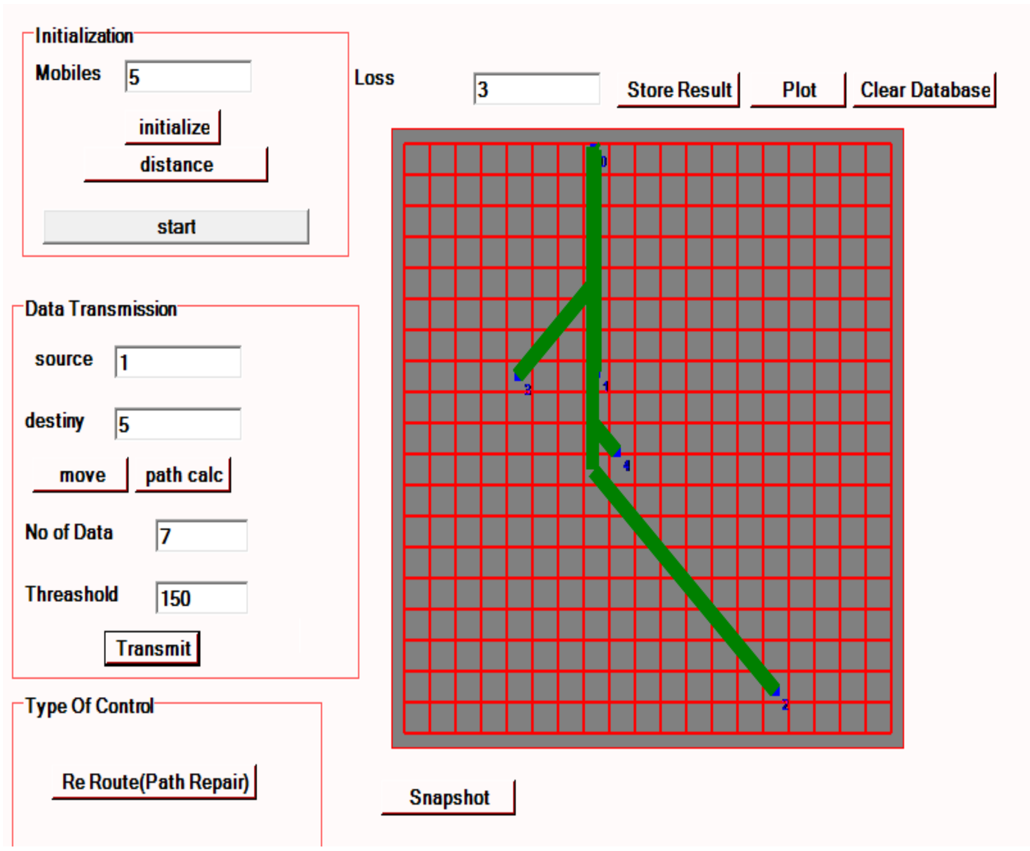

Figure 4: Joint optimal data rate for 5 destiny nodes

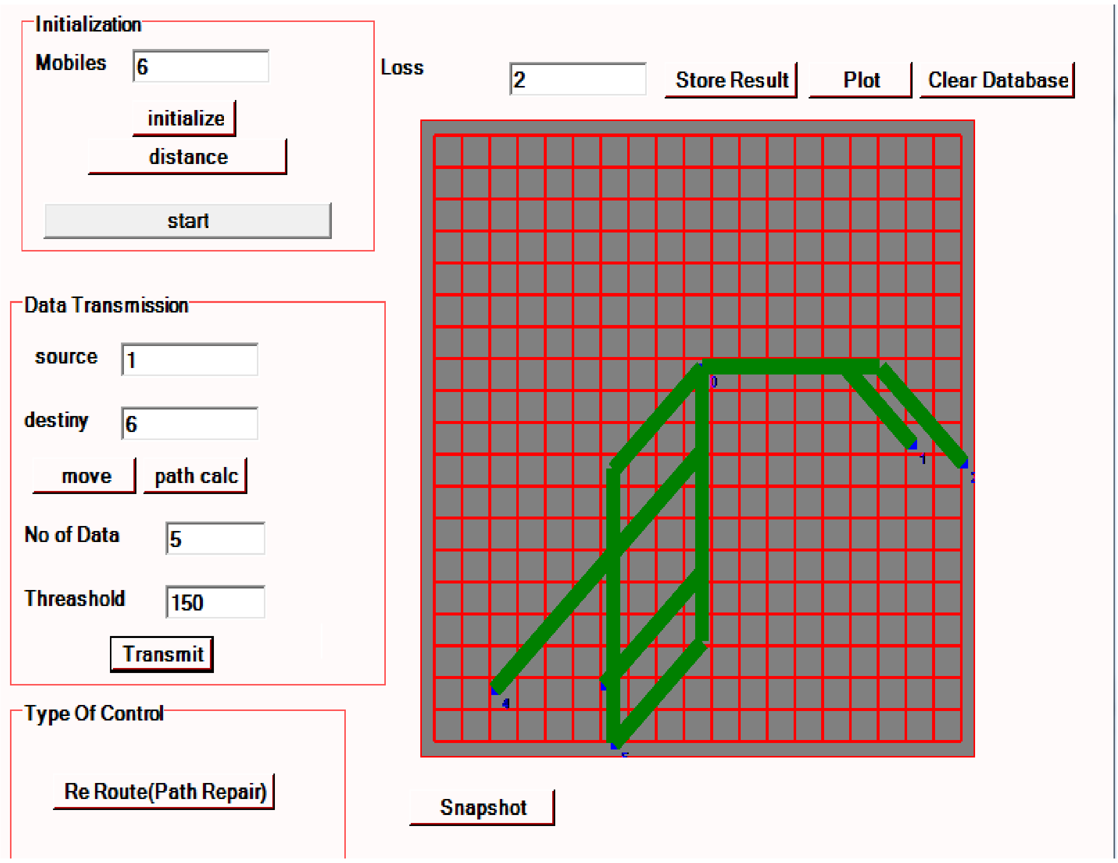

Figure 5: Joint optimal data rate for 6 destiny nodes

Table 1: Routing Protocols and their density

Protocol	Density	Routing Protocol
WCR2009	7.8	Least hops transmit
WCYR2011	7.8	Least hops policy
CDSNT2013	11.2 - 352	One hop transmit
BPS2015	8.7 - 707	Convergecast

Table 2: Routing Table

Destination Node	Next Hop Node in Local Topology
node 110	node 110
node 115	node 110
node 120	node 110
node 125	node 130
node 130	node 130
node 135	node 130
node 140	node 130
node 145	node 145
node 150	node 145
node 205	node 130

CONCLUSION

In this paper, the routing overhead in MANET by introducing probabilistic rebroadcast mechanism based on neighbor coverage knowledge which includes additional coverage ratio and connective factor. Considering, lossy mobile ad hoc networks where the data rate of a given flow becomes lower and lower along its routing path. Because of less redundant rebroadcast, the proposed work will mitigate the network collision and contention; this will increase the packet delivery ratio and reduce the average end to end delay. Although the network is in high density or the traffic is heavily loaded, the proposed work will have good performance.

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