# EFFICIENT ROUTING AND CHANNEL ASSIGNMENT IN MULTICHANNEL MOBILE ADHOC NETWORKS

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**ABSTRACT - By assigning orthogonal channels to neighboring nodes, one can minimize both types of interferences and allow concurrent transmissions within the neighborhood, thus improving the throughput and delay performance of the ad hoc network the capacity of mobile ad hoc networks is constrained by the intra-flow interference introduced by adjacent nodes on the same path, and inter-flow interference generated by nodes from neighboring paths three novel distributed channel assignment protocols for multi-channel mobile ad hoc networks protocols combine channel assignment with distributed on-demand routing, and only assign channels to active nodes proposed protocols can effectively increase throughput and reduce delay, as compared to several existing schemes, thus providing an effective solution to the low capacity problem in multi-hop wireless networks.**

**Keywords: AODV, CA-AODV, Ek-CA-AODV, Delay, Loss Ratio, Control Overhead, Throughput, and Packet Delivery Ratio.**

## I. INTRODUCTION

In this modern world, Wireless Communication has become indispensible part of life. Research focuses on Mobile Ad hoc Networks (MANETs), which is a collection of mobile devices by wireless links forming a dynamic topology without much physical network infrastructure such as routers, servers, access points/cables or centralized administration. Each mobile device functions as router as well as node. The main characteristics of MANET are i) Dynamic topologies ii) Bandwidth-constrained links iii) Energy constrained operation iv) Limited physical security [1, 2].

The maximum capacity that the IEEE 802.11 MAC can achieve for a chain network could be as low as just one seventh of the nominal link bandwidth all current IEEE 802.11 physical (PHY) standards divide the available frequency into several orthogonal channels, which can be used simultaneously within a neighborhood. IEEE 802.11 WLANs that operate in ad hoc mode rarely use multiple channels simultaneously. IEEE 802.11 MAC is not designed to operate with multiple channels, resulting in a waste of precious network resources. An ad hoc network based on the IEEE 802.11a technology utilizes only one out of 12 available orthogonal channels, wasting more than 90% of the potentially available spectrum. There has been substantial interest in multi-channel MAC schemes that can achieve higher throughput by exploiting multiple available channels every node has its own unique channel [1] Therefore, no channel assignment or selection is needed. The number of channels is limited and has to be carefully assigned to each node, in order to avoid contention and collisions only a few heuristic solutions which have good performance under certain environments, for instance, in a static wireless network [3].

## II. RELATED WORK

Many researchers have proposed many different approaches to MAC for utilizing multi-channel and multi-interface in mobile ad hoc networks.

In [5] the authors proposed a centralized channel assignment scheme where traffic is directed towards specific gateway nodes in static networks. A hybrid channel assignment scheme [4] assigns some radios statically to a channel and some are dynamically changed their frequencies in the channel. A new channel assignment scheme [5] for utilizing multi-channels that can be reduced channel conflicts by removing hidden channel problem [3].

All the protocols in NS 2.34 have only Single- Interface Single-Channel (SISC) support because IEEE 802.11 a/b/g requires some modifications on MAC and link layer protocols in order to utilize multi-interface multi-channel (MIMC).

The main Area of work will be to work on the Implementation of the three Protocols which will help to effectively reduce the Interferences in the Wireless Networks and increase the Throughput and Reduce the Delay in the Network.

We propose several modifications on CA-AODV routing protocol to utilize the multi-interface multi-channel (MIMC) scheme efficiently, to improve network performance.

Three principles for designing efficient distributed channel assignment schemes.

i. To reduce the complexity of the channel assignment algorithm, channel assignment and routing should be jointly designed. Exploring this design principle can potentially reduce the complexity of channel assignment algorithms.[1]
ii. Channels should be assigned only to active nodes. This on-demand channel assignment principle is motivated by the fact that only nodes on active routes need valid channels.[1]
iii. The capacity of mobile ad hoc networks can be adversely affected by both hidden terminals and exposed terminals. To improve network performance, distinct channels should be assigned such that hidden terminals, exposed terminals, and cumulative interference can be avoided as much as possible.

## III. ROUTING PROTOCOL

3.1 Combined Channel Assignment and AODV Protocol (CA-AODV) Like the original AODV routing protocol and many other reactive protocols, CA-AODV has two phases: route discovery and route reply. The route discovery phase is initiated only when a source node needs to send one or more packets to a destination to which the source does not have an up-to-date route. The route reply phase is initiated when the destination node or an intermediate node that has a valid route to the destination receives the Route Request (RREQ) message and generates a Route Reply (RREP) message.

3.2 Enhanced k-hop Channel Assignment and AODV Protocol (Ek-CA-AODV)

CA-AODV avoids channel collisions on a per route basis. Thus, it works well only when there are few active routes co-existing in a k-hop neighborhood. To improve the performance of CA-AODV, an extension of CA-AODV, called Ek-CA-AODV, is proposed.

Ek-CA-AODV introduces an extra control message called “ChannelTaken”. Most of the operations of Ek-CA-AODV are similar to those of CA-AODV except for the operation involving the extra control message “ChannelTaken”. If a node on an established route detects that a new route in the neighborhood is being set up, it broadcasts a “ChannelTaken” message that carries its own channel index. The TTL of the “Channel Taken” message is set to k to ensure that the “Channel Taken” message is broadcast only to the current node's k-hop neighbors. Upon receiving a “Channel Taken” message, any node will update its next-hop neighbor table and the available channel set A. If a channel conflict is detected by a node that is not yet on an established route, this node sets a “channel conflict “flag. When receiving a RREP message, a node checks to see whether the “channel conflict “flag is set. If so, the node will randomly pick another channel from the channel set A. Therefore, an inactive node updates its channel whenever a “channel conflict “occurs.

Through “ChannelTaken” messages, channels taken by nodes on established routes can be conveyed to other nodes in the network. Therefore, conflicting channels within the k-hop neighbourhood can be largely avoided, provided that the number of available channels is sufficient. To allow sufficient time for “ChannelTaken” messages to propagate to all nodes within the k-hop range, the destination node or a node that has a valid route to the destination should wait for a period of time, denoted by Wt, before sending back the RREP message. Wt is related to both k and tp, where tp is the per hop propagation time. If Wt is set to a large value, it will increase routing delay. If Wt is chosen to be too small, “ChannelTaken” messages may not propagate to nodes on the route being established and thus adversely affect the performance of channel assignment.

## IV. QUALITY OF SERVICE (QOS) METRICS

Quality of Service (QoS) Metrics [4, 5] is quantitative measures that can be used to evaluate any ad hoc routing protocol. The following metrics are considered in order to compare the performance of CA-AODV with route Discovery and Proposed CA-AODV with Neighbor Discovery.

A. Packet Delivery Ratio B. Throughput

C. Routing Overhead D. Normalized Routing Overhead E. End-to-End Delay

## V. SIMULATION AND EXPERIMENT

5.1 Simulation Model

The performance analysis is done by using NS 2.34. The following Fig 1 illustrates the simulation model and the simulation parameters are described in Table 1.

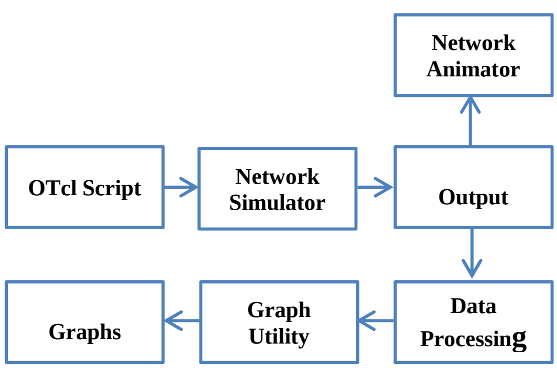



Fig 1: Overview of the simulation model

The simulator is written in C++ and a script language called OTcl. The OTcl script defines the number of nodes, links, the traffic in the network and which protocols it will use. This script is then used by NS during the simulations. The result of the simulations is an output trace file that can be used to do data processing (calculate delay, throughput etc) and to visualize

## VI. RESULTS AND DISCUSSIONS

Using results from the ns2 simulator, the performance of distributed channel assignment

the simulation with a program called Network Animator (NAM).

The Experiment is carried out in Shadowing:- Reflectors in the environment surrounding a transmitter and receiver create multiple paths. Multiple copies of the signals lead to Multipath propagation.

These Experimental results are taken in various scenarios like,

a) By varying speed density
b) By varying node mobility
c) By varying pause time by keeping other parameters constant.

Below the experimental results of the same is plotted under same conditions for shadowing.

Table 1: Simulation Parameters

| Parameter | Value |
|---|---|
| Transmission Range of a node | 250m |
| Interference Range of a node | 500m |
| Wireless Interface MAC | 802.11 |
| Channel Type | Wireless Channel |
| Signal Propagation Model | Shadowing |
| Transport Protocol Used | AODV,CA-AODV |
| Simulation Time | 100 Sec |
| Network Topologies Used | Static / Mobile Random |
| Simulator | NS 2.34 |
| MAC Type | 802.11 |
| Antenna Model | Omni |
| Traffic Type | CBR |
| Data Payload | 512 Bytes / packet |
| Network Load | 4 packets / sec |
| Interface Queue Length | 10 |
| Interface Queue Type | DropTail / PriQueue |
| Number of Nodes | 100 |
| Speed | 5,10,20,50,100 |
| Mobility | 0,5,10,25,50 m/s |
| Pause | 1,2,5,10,15 m/s |

protocols, such as CA-AODV and Ek-CA-AODV, is examined Simulation results are also presented to illustrate the capacity improvement of distributed channel assignment combined with MC-MAC compared to the single-channel IEEE

802.11 MAC. Because Ek-CA-AODV is suitable for static wireless networks, the performance of the Ek-CA-AODV protocol is studied in four static wireless networks, namely a one-hop network, a chained network, a square grid network, and a non-square grid network.

Table 2: Shadowing with varying speed

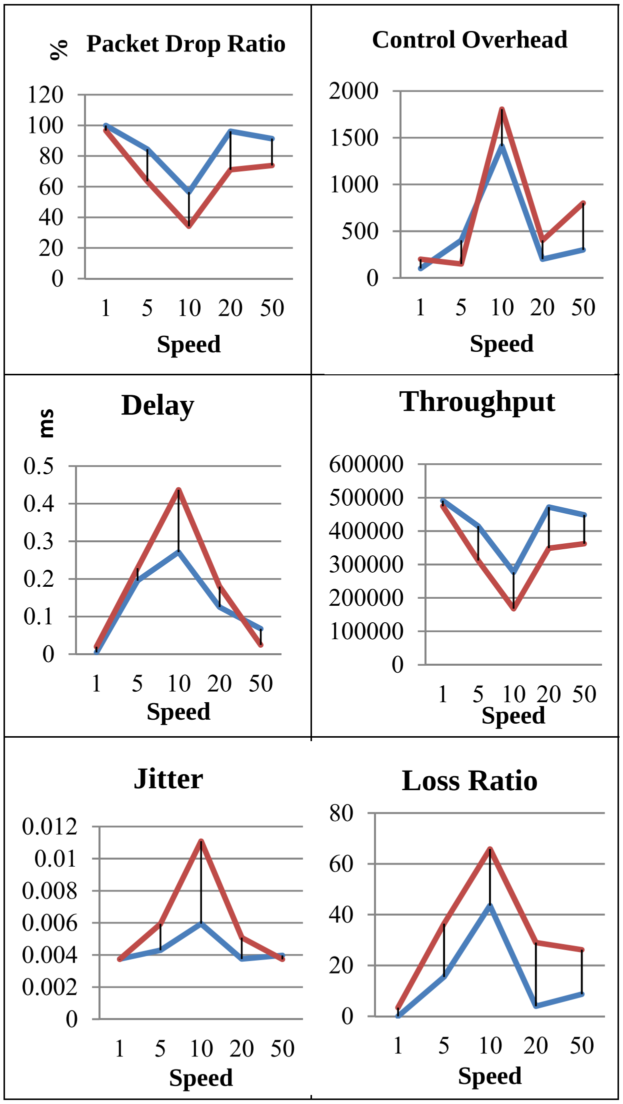



Table 3: Shadowing with varying pause

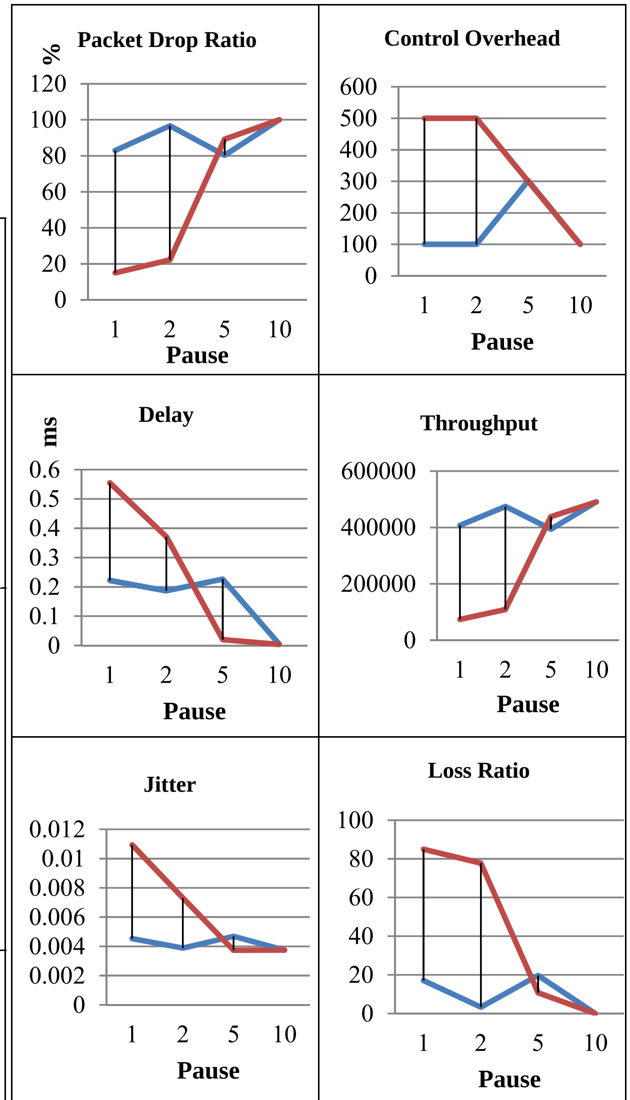
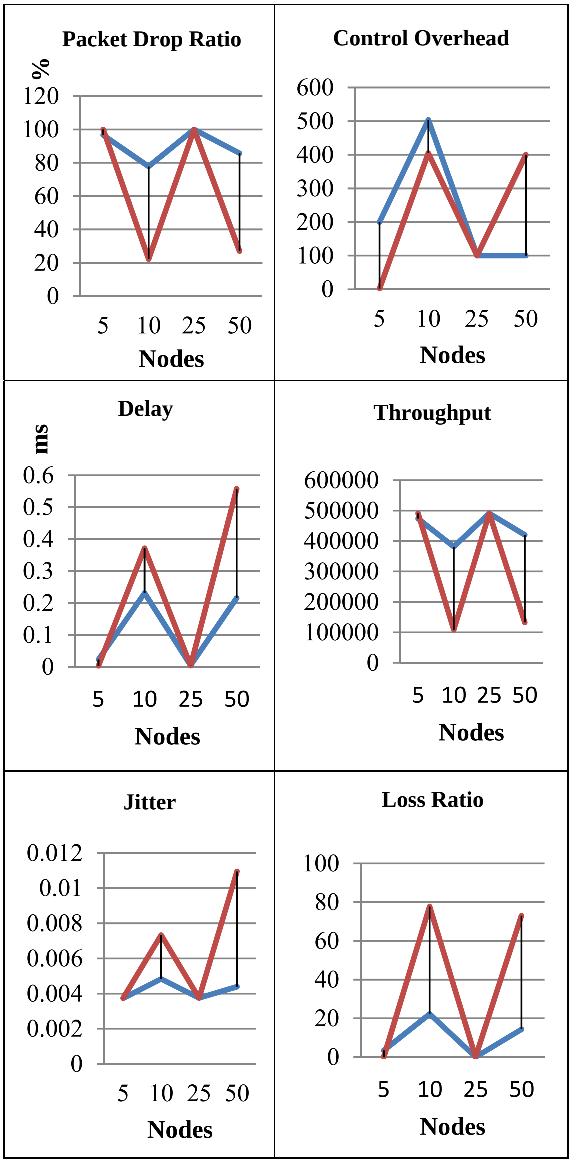


Table 4: Shadowing with varying nodes




## VII. CONCLUSION

Channel interference is major challenge in the ad-hoc network. It affects the network throughput, delay performance. In order to reduce the interference existing approach allocates the channel during the route discovery phase which slightly increase the delay due to the time needed for route discovery. Also Proposed method of channel assignment is relies on neighbor discovery phase as opposed to which depends on route discovery phase and adds too much control overhead.

Whereas, the new channel allocation technique carried in this dissertation is based on neighbor discovery. This approach allocates suitable channel from the available set of channels at the time of neighbor discovery which results into low control overhead and low delay .Thus new channel allocation technique increases the capacity of the network.

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