**International Journal of Recent Development in Engineering and Technology**
**Website: www.ijrdet.com (ISSN 2347 - 6435 (Online)), Volume 2, Special Issue 3, February 2014)**
**International Conference on Trends in Mechanical, Aeronautical, Computer, Civil, Electrical and Electronics Engineering (ICMACE14)**

# An Efficient Time-Stamp Based Compensation Scheduling Protocol For Multihop Wireless Network

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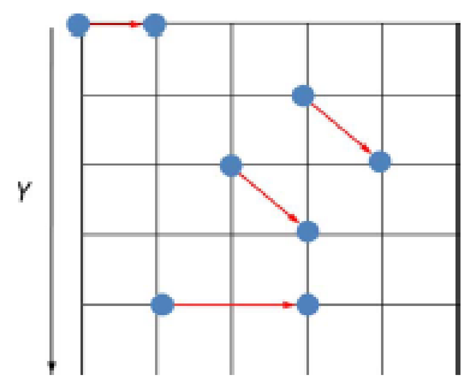
***Abstract*— Wireless network is one of the most innovative network topologies. In a mobile network with a time-varying topology does not seem reasonable to expect all nodes to an instantaneous network.It is a challenging task to develop scheduling algorithm with channel and topology uncertainty.Scheduling algorithms developed till now depend only on peer-peer communication and does not identify the channel error. Here, an efficient timestamp – based compensation scheduling protocol is proposed for multihop wireless network.This protocol is used for the purpose of finding Channel error and it also supports multihop traffic flow.**

***Index Terms* —Mobile Adhoc Network(MANET),Time-Stamp Based protocol(TSBP),Near-Optimal Scheduling.**

## I. INTRODUCTION

Mobile ad hoc networking is one of the most innovative emerging networking technologies and has broad applications in various domains.Mobile nodes communicate with each other using wireless communication, where simultaneous nearby transmissions can cause significant interference. To develop a high-performance mobile ad hoc network, a key step is to design scheduling algorithms that selectively activate a subset of links according to the known network state information in order to avoid excessive interference as well as maximize network throughput. Here scheduling algorithms for mobile ad hoc networks with time-varying (fading) channels.

Consider a network with sender-receiver (S-R) pairs, where the S-R pairs move according to Markovian processes. Consider that each mobile knows its own current position and instantaneous channel state, but it only has other mobiles' information with delay. This information delay along with the lack of global network state induces uncertainty and inconsistency in the topology knowledge and network state information (due to the fact that different mobile nodes have different "views" of the network). Our focus of this paper is to first understand the fundamental network throughput region under the information inconsistency and topology uncertainty, and then develop online scheduling algorithms that are optimal or near optimal.




S-R pairs developed in a square area with side-length Y

A.MAIN CONTRIBUTIONS :

There are 3 main contribution are

- First characterize the network throughput region under the information structure that each pair has its own instantaneous channel and geographic information, but other pairs information with a delay of time slots.
- Each mobile first computes a location-based threshold function based on the global delayed information and statistical information. The input of the location-based threshold function for S-R pair is their current location, and the output is a nonnegative value used to compare with the current channel state of S-R pair l.
- Finally, partition the geographic region spatially into disjoint and interference –free sub areas and delayed topology and network state information are shared only amoung nearby mobile nodes.

B.RELATED WORKS:

Throughput-optimal routing/scheduling algorithm was first proposed . Assuming that all mobile or static nodes have perfect global knowledge of the queue, channel and topology state, throughput-optimal routing/scheduling algorithms have been developed for different networks .There has also been much work in developing distributed and low-complexity implementations for a survey.

There have been some studies in the context of incomplete network state information (missing/delayed channel, queue or topology state). To the best of our knowledge, the earliest work to consider delayed queue-length information and its impact on stability of back-pressure algorithms . In a down-link/up-link wireless scenario that explore the trade-off between channel measurements and opportunistic gain.

With independent and identically distributed channels and a static network,has developed routing/scheduling algorithms with noisy channel estimates.

## II.MODELS AND NOTATION

Wireless network with sender-receiver (S-R) pairs. It is to denote the set of the S-R pairs. Initialize the name of the sender of pair to be sender, and the receiver of pair to be receiver .Without loss of generality, assume the S-R pairs are deployed in a square area with side-length.

Traffic Model: Consider a single-hop traffic. There is a traffic flow from sender l to the receiver l for l € L and sender l does not communicate with other receiver than receiver l.

Mobility Model: Consider a discrete-time system.Consider that the pairs move at the beginning of each time slot, and stay still within a time slot. The mobility of each pair is Markovian on a discrete square-lattice over the square region, i.e., the next location of a mobile is determined by its current location, and does not depend on the other history information, and the next location.

Channel Model: Assume that a time-varying wireless channel between each S-R. Denoted by the channel capacity of pair at time, which is the maximum number of packets that can be reliably transmitted over link at time.

Information Set for Sender l: The delays depend on node distances and may be time varying, so sender may have heterogenous delays from other nodes. Consider a homogeneous delay, so that the problem is tractable, and leave the heterogeneous delay case for our future research.

Scheduling –Decision Vector: Define a vector A(t) to be the scheduling-decision vector at time such that Al(t)=1 if the sender transmits at time and otherwise. Note that Al(t) is a function of the information available to sender l.

Location Based Threshold Scheduling: A location-based threshold scheduling policy is defined by a real-

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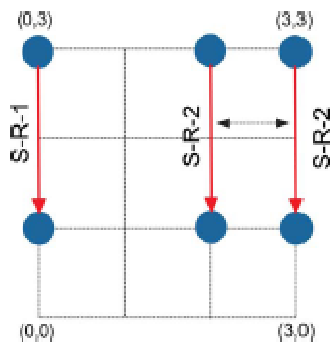
valued function, where the inputs are locations and the output is a real number.

The form of the function is determined by the delayed channel and queue length information available at the sender, and is independent of current locations and channel state.

Interference Model: Assume a geographic-based collision model. If two links interfere with each other, simultaneous transmissions on the two links will lead to a collision and no information (packet) can get through.




Mobile ad hoc network example

## III.THROUGHPUT-OPTIMAL SCHEDULING ALGORITHM WITH TOPOLOGY UNCERTAINTY

In this section, we first characterize the network throughput region under channel and topology uncertainty.

### A. Optimal Throughput Region

It is easy to see that the transmission rates of the pairs at time are determined by the following three parameters: 1) channel condition C{t}, 2) network topology, which is defined by the mobiles' positions (S{t},R{t}) , and 3) the scheduling decision A{t}.

Now assume thatC{t}=$c_1$ (S{t},R{t})=(s,r), and A{t}=a.Under the collision-model defined in Section II, a maximum link rate can be achieved over link l if there is no other active pairs interfering with pair l ; otherwise, the link rate is zero.

Mathematically, we can define a link-rate vector $L_{\{c1(s,r),a\}}$ such that

$$L_{\{c,(s,r),a\}l}=c_t$$

if $a_1$=1, and $a_h$=0 for any pair h such that $|s_h-r_1| \leq (1+\Delta)|s_l r_l|$; and

$$L_{\{c,(s,r),a\}l}=0$$

otherwise.

### B. Throughput-Optimal Scheduling Algorithm

In this section, we propose a throughput-optimal schedulingalgorithm which stabilizes the network for μ(t) within the network throughput region.

Threshold-Based Scheduling: Given the delayed information Q{t-$\mu_q$} and

$$\mathbf{J}[t-\tau] := \{\mathbf{C}[t-\tau], (\mathbf{S}[t-\tau], \mathbf{R}[t-\tau])\}$$

## III. Low-Complexity And Near-Optimal Implementation

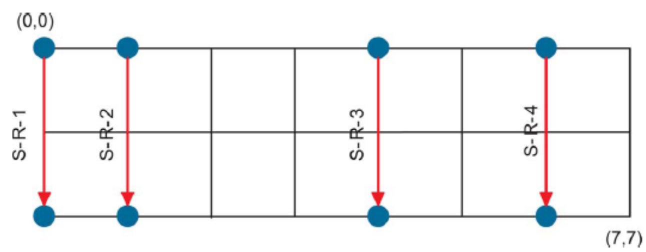
In this section, we propose a scheduling algorithm whose information and computation complexity is independent of the network size. The idea is to partition the geographic region spatially into disjoint and interference-free sub-areas and only share delayed topology and network state information among nearby mobile nodes. Then the computation complexity is determined by the size of the sub-area. We note that this partition idea has been successfully used in literature to develop low complexity approximations for NP-hard problem such as low complexity scheduling algorithms.

In this section, we have additional assumptions as follows:

• The distance a mobile can move at the beginning of a time slot is no more than $k_{max}$ .

• The distance between a sender and a receiver is upper and lower bounded. Denote by $_{Dmin}$ and $D_{max}$ the lower and upper bounds, respectively.

• Each mobile is equipped with a GPS or appropriate technology(e.g., cell tower based triangulation), so the mobiles have knowledge of their geographic locations.

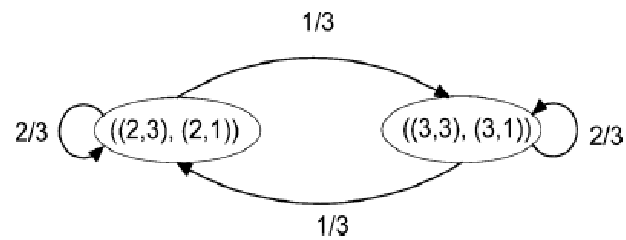



## IV. Time-Stamp Based Compensation Protocol Implementation

Timestamp-Based Compensation Protocol (TBCP) is for multihop wireless networks, under which channel errors are considered.TBCP adopts Start-time Fair Queueing (SFQ) as its scheduling discipline and selects the start tag as its service tag. In TBCP, the transmission order of a packet is determined with the service tag of the packet, the number of slots per frame a flow can use, and flow's Q-size. Then, eachnode exchanges the information about the transmission order of packets with its neighbors. Thus each node knows the service tags of other nodes, and also learns when it will transmit packets. Each node keeps monitoring its channel state. When the channel is error-prone, the node stops exchanging transmission messages with its neighbors. Once the channel recovers, the error-prone node resumes the exchanges. Consequently, if this node has packets with service tags smaller than its neighbors after recovery, these packets still have higher priority to be transmitted. Multihop flows are also handled by TBCP with introducing new parameter called Q size.

*Mobility Pattern:*In mobility management, the random waypoint model is a random model for the movement of mobile users, and how their location, velocity and acceleration change over time. Mobility models are used for simulation purposes when new network protocols are evaluated. The random waypoint model is one of the most popular mobility models to evaluate mobile ad hoc network (MANET) routing protocols, because of its simplicity and wide availability. In random-based mobility simulation models, the mobile nodes move randomly and freely without restrictions. To be more specific, the destination, speed and direction are all chosen randomly and independently of other nodes.

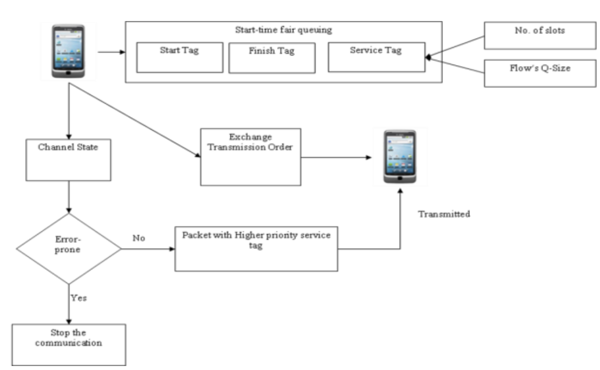
The movement of nodes is governed in the following manner: Each node begins by pausing for a fixed number of seconds. The node then selects a random destination in the simulation area and a random speed between 0 and some maximum speed. The node moves to this destination and again pauses for a fixed period before selecting another random location and speed. This behavior is repeated for the length of the simulation.




Markovian Mobility example

*Characterize network throughput region:* Here, first characterize the network throughput region under the information structure that each pair has its own instantaneous channel and geographic information, but other pairs' information with a delay of time slots.

It is easy to see that the transmission rates of the pairs at time are determined by the following three parameters: 1) channel condition, 2) network topology, which is defined by the mobiles' positions, and 3) the scheduling decision.



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*Start-Time Fair Queuing algorithm:*In Start-time Fair Queuing algorithm (SFQ) two tags, a start tag and a finish tag, are associated with each packet. However, unlike WFQ and SCFQ, packets are scheduled in the increasing order of the start tags of the packets. Furthermore, v(t)is defined as the start tag of the packet in service at time t. The complete algorithm is defined as follows:

1. On arrival, a packet is stamped with start tag
2.Initially the server virtual time is 0. During a busy period, the server virtual time at time t, v(), is defined to be equal to the start tag of the packet in service at time t. At the end of a busy period, is set to the maximum of finish tag assigned to any packets that have been serviced by time t.
3. Packets are serviced in increasing order of the start tags; ties are broken arbitrarily (some tie breaking rules may be more desirable than others.

As is evident from the definition, the computation of v(t)in SFQ is inexpensive since it only involves examining the start tag of packet in service. Hence, the computational complexity of SFQ is same as SCFQ, which is O(logQ)per packet, where Qis the number of flows at the server.

Traditionally, scheduling algorithms have been analyzed only for servers whose service rate does not vary over time. However, service rate of flow-controlled, broadcast medium and wireless links may fluctuate over time. Fluctuation in service rate may also occur due to variability in CPU capacity available for processing packets (for example, a CPU constrained IP router may not have sufficient CPU capacity to process packets when routing updates occur). If a server is shared by multiple types of traffic with some traffic types being given priority over the other, then for lower priority traffic, the link appears as a server with fluctuating service rate. In order to accommodate such scenarios, we analyze SFQ for servers with bounded fluctuation in service rate.

*Channel state analysis:*There are basically two levels of CSI, namely instantaneous CSI and statistical CSI.

*Instantaneous CSI (or short-term CSI);* means that the current channel conditions are known, which can be viewed as knowing the impulse response of a digital filter. This gives an opportunity to adapt the transmitted signal to the impulse response and thereby optimize the received signal for spatial multiplexing or to achieve low bit error rates.

*Statistical CSI (or long-term CSI) :*means that a statistical characterization of the channel is known. This description can include, for example, the type of fading distribution, the average channel gain, the line-of-sight component, and the spatial correlation. As with instantaneous CSI, this information can be used for transmission optimization.

The CSI acquisition is practically limited by how fast the channel conditions are changing. In fast fading systems where channel conditions vary rapidly under the transmission of a single information symbol, only statistical CSI is reasonable. On the other hand, in slow fading systems instantaneous CSI can be estimated with reasonable accuracy and used for transmission adaptation for some time before being outdated. If the channel state is error prone in the sense the communication is stopped. Else the packet with highest service tag is transmitted to the receiver.

## V.Simulation Result

*Performance Evaluation:*The performance of the proposed scheme is evaluated by plotting the graph. The parameter used to evaluate the performance is as follows: Average Queue length shown in figure 1, Packet loss ratio shown in figure 2, End to end delay shown in figure 3 and throughput shown in figure 4. These parameters are recorded during the simulation by using record procedure. The recorded details are stored in the trace file. The trace file is executed by using the Xgraph to get graph.

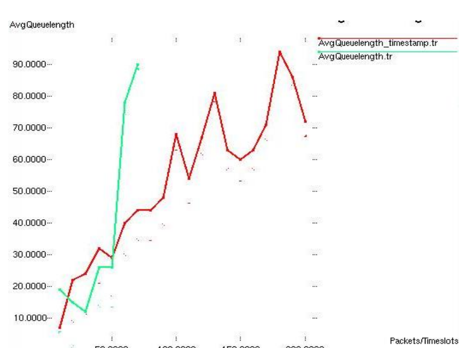


Fig 1.Performance of Average Queue Length

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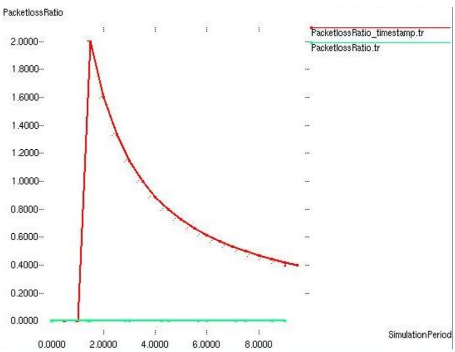

Fig 2.Performance of Packet Loss Ratio

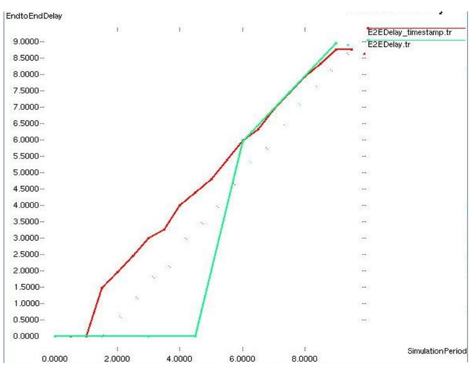

Fig 3.Performance of End to End Delay

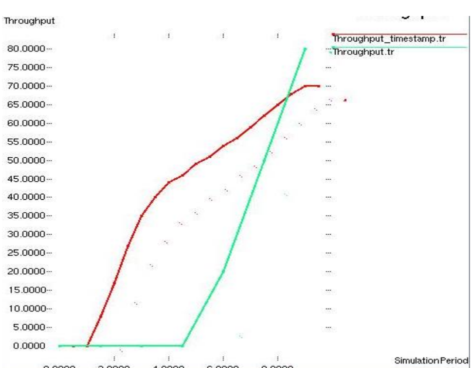

Fig 4.Performance of Throughput

## VI.Conclusion And Future Enhancement

Throughput-optimal scheduling for mobile ad hoc networks with information delays. Here we characterized the network throughput region under channel and topology uncertainty. We also proposed a scheduling algorithm where the scheduling decisions are made based each mobile's instantaneous information and delayed information from local geographic regions. And also considered multi-hop traffic flows instead of only peer-to-peer communications and considering physical interference model and design joint power control and scheduling algorithms.Based on this throughput and End to End delay will increase and compress Packet Loss Ratio and Average Queue Length.

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