DESIGN AND SIMULATION OF CLOCK SYNCHRONIZATION ALGORITHM FOR MOBILE AD HOC NETWORK

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***Abstract*—**

This paper gives brief introduction about clock synchronization in wireless mobile ad-hoc networks. Here we will discuss about the clock synchronization problem and scalability of MANETs. Also we will discuss about the major scopes for synchronization in MANETs. We will discuss various algorithms proposed as solutions for the problem of clock synchronization in MANETs. Here we will discuss about TSF(timing synchronization function),MASP(Modified automatic self-timing procedure). At last we will compare the results for the throughput, end to end delay and energy parameters which are very important for the efficient utilization of the wireless adhoc networks.

Keywords— MANET, clock synchronization, TSF, MASP, Scalability, energy, end to end delay

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I. INTRODUCTION

The Wireless ad hoc Network is a decentralized type of wireless network. The Network is ad hoc because it does not on a pre-existing infrastructure, such as routers in wired networks or Access points in managed (infrastructure) wireless networks. Instead[1,2] each node participates in routing by forwarding data for other nodes and so the determination of which nodes forward data is made dynamically based on the network connectivity.

Clock synchronization is important for frequency hopping and power management both FHSS and DSSS. Without such Clock synchronization ,mobile hosts may not wake up at the same time and thus the power management operation also not work properly.

The problem here to achieve global clock synchronization in 802.11 based Ad hoc networks. The Difference between the largest and the smallest clock values among all stations in a ad hoc network is called maximum clock offset. Here We will try to achieve the results so as to minimize the value of this clock offset. In case of Multi-hop Ad hoc networks scalability is also a big issue which we need to analyse and we need to Reduce its effect on implementation of synchronization Algorithm.

One of the problem of synchronization protocol is how to obtain the global clock.The Methods to achieve Synchronization are make use of master node ,intermediate node and mutual synchronization

The Methods Which introduce A time server as a node,the NTP(Network Time Protocol) is a representive.But the networks such as Ad hoc do not easily configure to tine server because of self organization and with no central nodes,resulting in a single point failure problem. Methods which use the fastest node as master node,such as the 802.11 defined TSF and ASP faced the problem of diveregence which make the clocks faster and faster.In case of MATSF it needs to dynamically create the leading tree,and if the nodes move the trees must be re-created leading to overhead.Another algorithm MATSF requires much hugher costs to calculate the requency of transmitter.

Methods which use the conceprt of intermediate nodes such as RBS could not be applied to the multi-hop ad hoc networks because of the hidden terminal problem and information overload.

The Mutual network synchronization solutions,such as CSMNS(clock sampling mutual network synchronization), problems that rely on special nodes in the existing methods.Here we will discuss mainly about the methods related to the concept of the faster node.

II. CHALLENGES OF MANET

The are many issues while establishing[1,2] a MANET but I have deal here with the end to end delay and throughput parameters in this paper. This problem arises because of lack of synchronization between the nodes in the topology.

III. ALGORTIHMS TO SOLVE PROBLEM OF CLOCK SYNCHRONIZATION

A. *TSF*

In 802.11 TSF[3,4], clock synchronization is achieved by periodically exchanging timing information through Beacon Frames, which contains timestamps .IBSS(Independent Basic Service Set) is defined by 802.11 standards as an ad hoc network in which all of the stations are within each others transmission range.

According to the IEEE 802.11 specifications , each station maintains a TSF timer also known as clock in the range of microseconds. Each node in an IBSS shall adjust to the timing received from any beacon that has a TSF time value

(the timestamp) later than its own TSF timer. All nodes in the IBSS should adopt a common value ,known as Beacon period

,which defines the length of the of the beacon intervals or periods.

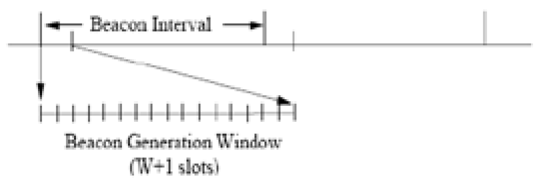


Figure 1

This value, established by the node that initiates the IBSS, defines a series of Target Beacon Transmission Times (TBTTs) exactly a Beacon Period time units apart. Time zero is defined to be a TBTT. Beacon generation in an IBSS is distributed, the nodes in IBSS takes part in the procedure as follows.

1) Beacon Generation and Clock synchronization

1. At each TBTT each node calculates a random delay uniformly distributed in the range between zero and 2.aCWmin.aslotTime.
2. The node waits for the period of the random delay.
3. If a Beacon arrives before the random delay timer has been expired ,the node cancels the pending beacon transmission and the remaining random delay.
4. When the random delay timer expires ,the node transmits a beacon with a timestamp equal to the value of the node's TSF timer1.
5. Upon receiving a beacon ,a station sets its TSF timer to the timestamp of the beacon if the value of the timestamp is later than the stations TSF timer2.

So as shown in the figure , at the starting of each beacon time interval ,there exist a Beacon generation window consisting of W+1 slots each of length aSlotTime, where W=2.aCWmin.Each node is scheduled to transmit a Beacon at the beginning of one of the slots.

B. *MASP*

1. In each beacon interval, node i checks whether its ci = pi. If so, node i will take part in contention for beacon transmission (follow the operations of IEEE 802.11). If the node transmits the beacon it will reset ci to zero. If not, go to step 4.

2. Cancel the random delay timer if a beacon is received from other mobile node before the timer has expired. The information in the received beacon is recorded in node i's Clock Table. If the

received timestamp is later than its time, host i will change its time to received time and increases its Seq_No and pi by 1.If the node that transmits the beacon is already in node i's Clock Table it checks the Seq_No and Self_Seq_No from the Clock Table and compare those with the current values. If values are unchanged apply ai calculations given in (7).If mobile node i already has a value ai, the maximum value will be selected. If the time received is smaller, decrement the pi by1.

3. Send a beacon if the random delay timer has expired and no beacon has arrived during the delay period.

4. At the end of a beacon interval, increase ci by 1.

5. Mobile host i automatically adjusts its clock on microsecond ahead in every ai microseconds.

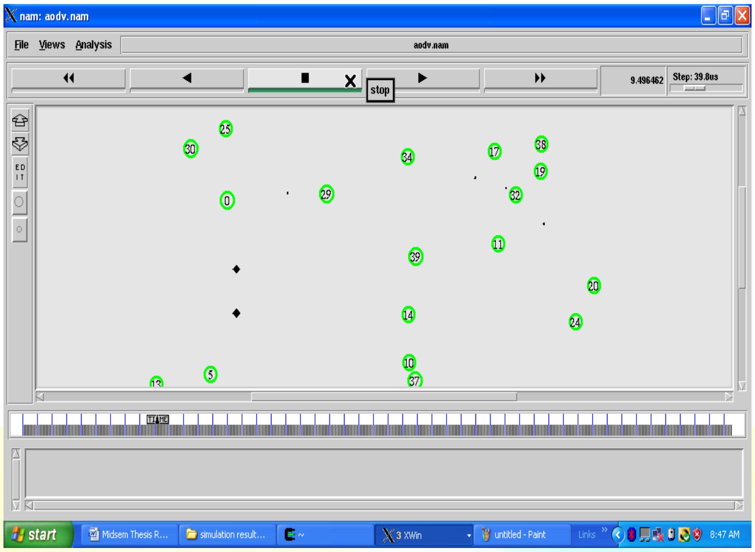
IV. ANALYSIS

Now it is really necessary to study the effect of synchronization on MANET .If it is Synchronized than the network according to its ideal efficiency but if it is not so than what are its adverse effect. For that we have to study the topologies with and without synchronization which are presented in the simulation results section.

V. SIMULATION RESULTS

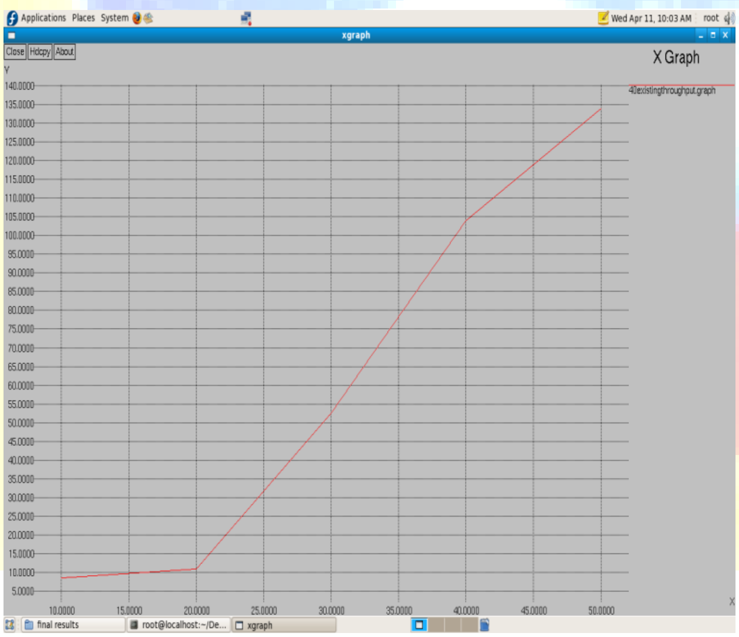
Here I have designed a topology for 40 nodes. Once I have simulated the topology without using clock synchronization procedure and next time simulations are made wit h use of clock synchronization procedure.

A. *Scenario for 40 Nodes*



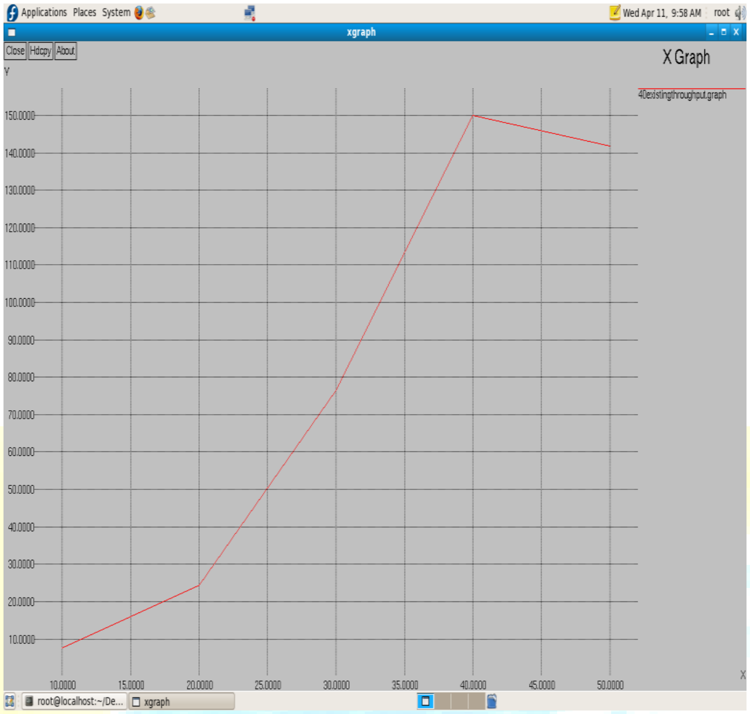
B. *Xgraph for Throughput v/s Simulation time without clock synchronization procedure*

X axis= simulation time ,Y axis= Throughput



C. Xgraph for Throughput v/s Simulation time with clock synchronization procedure

X axis= simulation time ,Y axis= Throughput



VI. CONCLUSION

From the results obtained in the table it can be analyzed that we can increase the throughput of the system by using the clock synchronization procedure as shown in the results. Also we increase the pdf i.e packet delivery fraction that means using clock synchronization procedure we can reduce the number of dropped packets. In this way we can improve the overall efficiency and increase the capacity of the Network.

Sim time	procedure	10	20	30	40	50
Remaining Energy	No syn	3893.44	3809.32	3778.03	3753.74	3623.61
	With syn	3912.94	3823.00	3757.04	3667.31	3581.87
Consumed Energy	No syn	106.55	190.67	221.96	246.25	376.38
	With syn	87.05	167.875	242.95	312.68	41.125
Send Packet	No syn	1001	2000	3000	4001	5001
	With syn	1001	2000	3000	4001	5001
Receive Packets	No syn	716	1221	2170	3120	3962
	With syn	581	1287	2287	3258	3823
Routing Overhead Packet	No syn	211	295	322	526	772
	With syn	129	394	394	669	1358
Normal Routing Load	No syn	0.29469	0.24160	0.14838	0.16859	0.19485
	With syn	0.222	0.3061	0.17227	0.205	0.3552
Pd fraction	No syn	71.52	61.05	72.3	77.98	79.22
	With syn	58.045	64.25	76.233	81.429	76.44
Average end to end delay	No syn	0.6784	0.8873	0.3194	0.2452	0.2376
	With syn	0.614	0.4216	0.24037	0.1755	0.2158
Throughput In kbps	No syn	8.54	11.00	52.60	104.00	137.86
	With syn	7.57	24.42	76.00	150.00	141.00

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