RELIABLE MULTICAST MULTI-PATH DATA DELIVERY IN WIRELESS AD HOC NETWORK USING TIME STANDARD PACKET ALLOCATION SCHEME

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ABSTRACT

IN Wireless network to maintain the higher throughput level on ad-hoc network data delivery, Median Multicast Throughput Data Delivery (MMTDD) mechanism is proposed in this paper. The basic idea of MMTDD mechanism is to divide a message into multiple shares and deliver them via multiple independent source paths to the destination. MMTDD mechanism with the average time standard takes the best threshold value for every data (i.e.,) packet partitioning by avoiding packet loss. By this means, MMTDD mechanism uses the Average Time Standard (ATS) to guarantee the required packet allocation with higher throughput level. With the ATS application, the MMTDD mechanism derives the theoretical model by attaining approximately 4% higher throughput level on the multipath data delivery in ad-hoc network. The nodes in the Wireless ad hoc network with dynamic in nature communicate with each other causing the interference during the multi-casting process, so that the plan is to avoid the multi casting interference using time scheduler and routing protocol. Spatial Time Scheduling Multiple Access (STSMA) Framework is proposed in this paper to perform the effective multicast scheduling in the wireless ad-hoc network.

Keywords : Multicast Reliable Data Delivery, Ad-hoc Network, Delivery Ratio, Average Time Standard, Time Scheduling, Throughput Level Spatial Time Scheduler, Wireless Network, Multicasting Routing Protocol.

I.INTRODUCTION

The physical outline of the ad-hoc network offers shortest association linking of the communication and quality of ad-hoc environment. Wireless devices provide higher speed and longer range of services in the ad-hoc network. A single path data transmission in ad-hoc network consumes more time to transfer the data packets than when compared to the multipath data transmission. Multipath data transmission in the ad-hoc network provides a wide variety of tradeoff paths for transmission of the packets.

Large number of studies has been conducted on the multi-hop wireless networks that are in a greater hand dedicated to the stability of the system by enhancing the metrics like throughput or utility. The delay performance is analyzed in multi-hop wireless network with the help of the fixed route selected between each source and

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destination pair. A new queue grouping technique was designed to provide solutions to complex correlations of the service process obtained with the use of multi-hop types of flow. But the queue grouping technique was not extended to the channel variations.

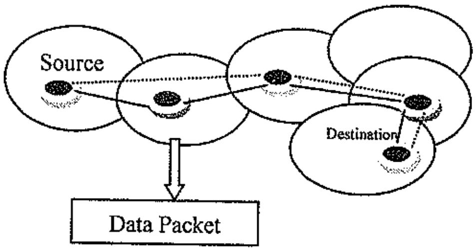

Figure1: Balanced State Flow Model on Multipath

Draining life from wireless through Vampire attacks developed with the common properties of protocol module on invalid network path . Routing protocol provably removed the damages but data delivery was not carried out with higher security ratio. Existing k-hop clustered networks as described in performed arbitrary walk mobility with non-trivial velocities. With the application of non-trivial velocities, the energy consumption was decreased and recovered the power delay trade off but multi hop transmissions (i.e.,) data delivery to the cluster head was not performed in wireless network.

Many surveillance applications including military and civil wireless sensor networks are significantly designed based on the assumptions that the nodes must be aware of their positions during transmission. But the conventional relative localization problem is not suitable while evaluating the overhead. To present a solution for this issue, a novel problem called essential localization was presented within a given time bound. Moreover an efficient distributed algorithm was also presented for time-bounded localization over a sensor network. But the work was only confined to certain protocols.

Network coding-based cooperative ARQ (NCCARQ-MAC) scheme as demonstrated in [12] performed multi-hop transmission among a set of relay nodes but the impact of realistic physical layer was not carried out during the data transmission. Distributed Cache Invalidation mechanism with the pull-based algorithm (DCIM) as illustrated in used adaptive Time to Live (TTL) in order to perform the correct update rates for the data source. With this Distributed Cache Invalidation mechanism obtained the next request time and pre-fetched the items that were requested. Distributed Cache Invalidation mechanism expected its next request time and pre fetched items requested accordingly. But the TTL algorithm failed to replace the running average formula while performing secure data delivery in wireless network.

Report-based payment scheme enclosed the suspected charges and rewards of different sessions as described in But different sessions without security proofs failed to continue with a trust value for every node data delivery in the wireless network. Reputation-based routing protocol as described in upholds the reputation of forwarding nodes in the wireless network. Reputation protocol composes acknowledgments, node lists, and aging but it will not provide the broadcast communication with minimal delay time.

Adaptive Beamforming System in integrated feedback rate and coherence scheduling time for considerably increasing the robustness with channel dynamics during multicasting wireless ad-hoc network. Client specific SNR-rate mapping was integrated with the user scheduling optimization problem but failed to reduce the overall schedule length in wireless LAN. Resource Biasing Approach as depicted in defined the wireless network service maximization problems. Mixed-bias strategies with maximization problem definition attain an advanced multicasting flow throughput profile and resourceful network utilization but detailed investigation was not performed on NUM based route time scheduling protocols.

Probability-based Prediction and Sleep Scheduling protocol (PPSS) recover the energy efficiency in with proactive wake up tasks. PPSS with distributed algorithm which executed on entity nodes, made PPSS scalable for large-scale WSN. But PPSS failed to optimize the sleep scheduling and target prediction on sudden transforms in sensor network. Robust Tracking (RT) algorithms and reasoning logics, as described in performed multicasting operation on the WiMAX infrastructure. RT algorithm does not offer the effectual optimization outcome while communicating with the help of multicast routing in wireless ad-hoc network.

Multiple receiver transmission (MRT) and the Fast NAV truncation (FNT) as illustrated in improved the receiver blocking problem which devoid of adopting additional control channels. The adaptive receiver transmission (ART) scheme enhanced the throughput performance with active alteration of chosen receivers but failed to validate the effectiveness of the ART protocol.

Energy-Efficient Multicasting as presented in build burst broadcast schedules with reduced energy utilization. But the energy-efficient multicasting did not improve the excellence of scheduling experience on the majority of multicast subscribers in WiMAX networks. Optimal Peer-to-Peer Scheduling (OPPS) method as described in with dynamic algorithm opportunistically extracted the packets from current neighbors. OPPS method attained significant throughput by wireless peering and node transmissions when the file availability probability was large. But the OPPS does not deal with the packet delay time scheduling problem in ad-hoc networks. Cross-Layer Scheduling as described in aimed to shift the definite queue backlog into the practical backlogs. Control and scheduling algorithm ALG with multi-hop model stabilized the network but it is not effective in power management and multicast scheduling policies in wireless ad-hoc network.

Epidemic-based multicast method as presented in dealt with the active and random topology changes due to mobility. Epidemic mechanism maintained the global view of the network by attaining the lower overhead. The variation of the node density reduced the performance of the system in ad-hoc network while performing the multicast operation. Multi-Channel Scheduler as described in performed the concatenation operation on the lesser load packets. The load packets were then placed into large frames and then sent to similar channels. Similar channel carried out the intelligent channel selection among intermediate nodes in wireless ad-hoc network. But the algorithm failed to decide the call admission on multicasting links according to the experiential information.

II. Data Delivery Mechanism For Median Multicast In Ad-hoc Network

The proposal work (i.e., MMTDD mechanism) addresses the throughput level on multipath data delivery in wireless network. The initial work starts with the division of packets into multiple parts. Followed by this, the multiple packet parts are allocated based on the Average Time Standard (ATS) on multiple paths in ad-hoc network. The MMTDD mechanism follows balanced state flow model to maintain high throughput level in the wireless multipath ad-hoc network. The architecture diagram of MMTDD mechanism using the ATS is described.

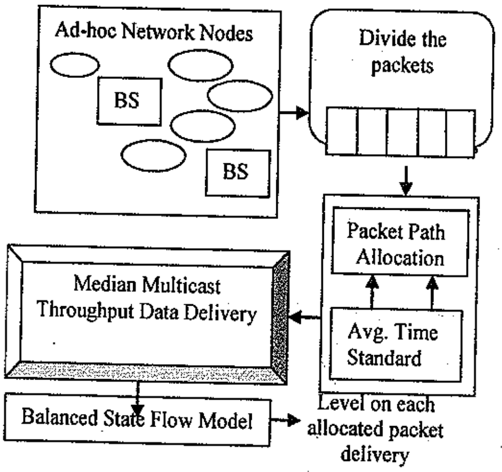

Figure 2 Architecture Diagram of MMTDD

Figure 2: Median Multicast Delivery

III. Data Packet Partitioning

The first process involved in the design of MMTDD mechanism is to partition the data packet. In MMTDD mechanism, the data packet partitioning uses a threshold value to divide the message into multiple parts. Threshold based data packet partitioning in ad-hoc network divides the data packets into 'n' parts. Each 'n' part in ad-hoc network contains the secret information respectively. The 'D' data packets of 'n' parts are taken based on the threshold value.

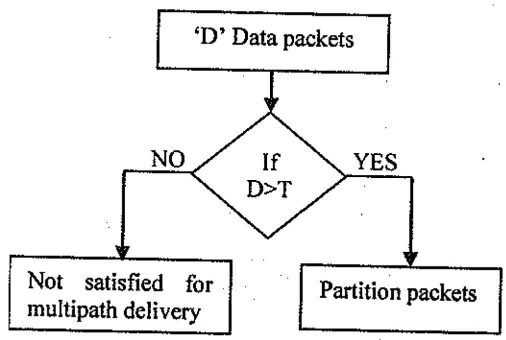

Figure 3: Data packet partitioning Rules

Figure 3 as given above shows the data packet partitioning rules. As illustrated in the figure, the data packets 'D' are partitioned based on the threshold Value 'T'. If the data packets are greater than the threshold value, then the partitioning operation is carried out. With a (D, n) the data packets are divided to perform the allocation task for the next step to be followed in the MMTDD mechanism. The generation of the data packets performs the partitioning with O ($D_{log}{}^2 D$) and section 2.2 describes the allocation of the partitioned data packets for higher throughput data delivery in ad-hoc network.

IV. Balanced State Flow Model

In MMTDD mechanism, the packet time is scheduled using the Spatial Time Scheduling Multiple Access method. The scheduled packet follows the balanced state flow model. In balanced state flow model, each ad-hoc network edges are partitioned into several packet flows based on the threshold value with the packet flow in MMTDD wireless network defines a transmission graph set. The transmission graph set in MMTDD is defined as TG (V, E, á), where V denotes the nodes in the network, E describes the Edges, and á denotes the function which will assign a transmission rate. The transmission rate function is defined as,

$$\alpha : E \rightarrow D^{+} \quad \text{......... Eqn (3)}$$

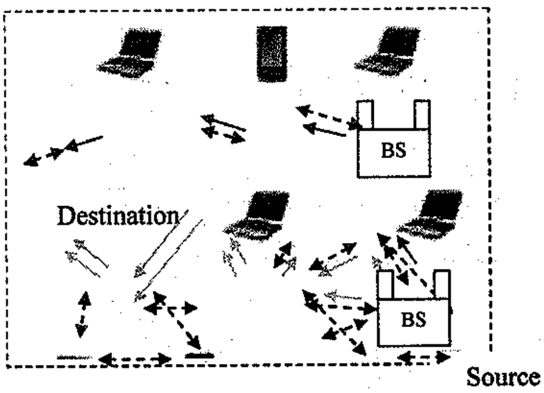

Figure 4: Balanced State Flow Model on Multipath

Path 1

Path 2

Path 3

Figure 4 describes the multipath data transmission in wireless network using the Balanced State Flow model. The source node transmits the partitioned packets to the destination using ATS. ATS based packet allocation on the route path helps to transmit the data packets in MMTDD mechanism with higher throughput level. Base Station 'BS' is also used in the ad-hoc network to avoid traffic congestion and improve the signal strength while transmitting through the wireless communication in MMTDD mechanism. MMTDD mechanism maintains higher throughput level on the multipath data delivery, and the throughput level is computed by summing up the median flow on each route path in ad-hoc network.

The overall throughput utilizes the Flow rate 'FR' for each route path 'P1', 'P2', 'P3'.....'Pn'. The flow rate of the entire ad-hoc network path (i.e.,) multiple path in balanced state model are summed up together to attain the high throughput level averagely. ATS chooses the path based on the partition packet size, so that the packet gets transmitted with minimal time consumption. The packet is allocated based on the level of the transmission rate in MMTDD mechanism as a result the throughput level is improved. Balanced state flow model in MMTDD mechanism is described below through the algorithmic steps,

Begin

//Balanced State Flow Model

Step 1: Ad-hoc network setup with 'N' nodes such that 'N1', 'N2', 'N3'... 'Nn'

Step 2: Data packets 'D' divided into 'n' (or parts) partition based on threshold value

Step 3: Divided data packets allocates on multiple path

Step 3.1: Based on the Average Time Standard

Step 3.2: Compute path $n - D + 1 \leq M_i$ for packet allocation

Step 3.3: Average Time Standard used to compute the overall packet allocation paths

Step 4: Plot the Transmission Graph set TG (V, E, á)

Step 4.1: Median Multicast Throughput Data Delivery through transmit function

Step 4.2: Compute transmit function $\alpha : E \rightarrow D^+$

Step 4.3: Balances the state flow with transmit function on each route path

Step 5: 'BS' avoids the traffic congestion, and improves transmission signal strength

Step 6: Compute flow rate $\sum_{i=1}^{M} FR\ (P1) + FR\ (P2) + FR(P3) \ldots FR\ (pn)$ of each path in as-hoc network

Step 7: Maintains High Throughput Level on each allocated packet delivery End.

V. Result Analysis Of MMRDD

The Median Multicast Reliable Data Delivery (MMRDD) mechanism in ad-hoc network is compared against the existing Trajectory-based Statistical Forwarding (TSF) method and Void Aware Pressure Routing (VAPR) method. The compared simulation results are analyzed through the table and graph form.

Table 1 : Tabulation of Time Consumption

Multiple Path Count (MP)	Throughput Rate (Kbps)		
	TSF Method	VAPR method	MMRDD mechanism
MP_2	980	999	1020
MP_4	1665	1602	1675
MP_6	2215	2298	2356
MP_8	2675	2712	2773
MP_10	3295	3325	3447
MP_12	3572	3591	3670
MP_14	4015	4035	4146
MP_16	4321	4387	4323

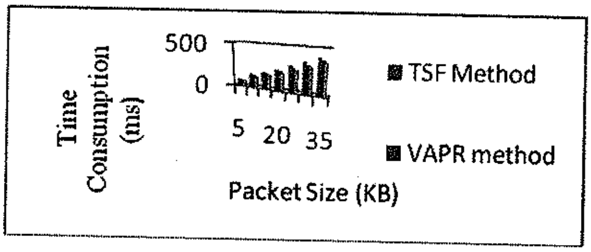

Figure 5: Performance of Time Consumption

The time consumption based on the packet size ranging from 5 to 35 KB. The Average Time Scheduler works to allocate and assigns the load to each link of the ad-hoc network as a result the proportional median time reduces the time consumption by 10 – 16 % when compared with the TSF Method .The load of the given path in MMTDD mechanism is used to avoid the excess time consumption while transmitting the packet on the ad-hoc network and therefore reduced to 5 – 11 % when compared with the VAPR method

Table 2 : Tabulation of Data Delivery Rate

VAPR method	MMRDD mechanism
44.5	45.5
84.1	91
125	144.2
171.5	188
221.4	2448
270.1	296.2
324.1	335.8

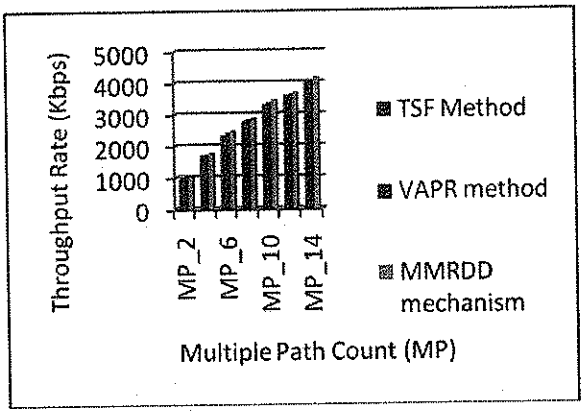

Figure 6 : Throughput Rate Measure

The throughput measure based on the multiple path count. With the introduction of the MMRDD mechanism, the throughput rate is high. This is because the path with Transmission Graph (TG) set in MMTDD produce the 2 – 6 % higher throughput level with maximum flow rate obtainable over edges. The transmission graph set and the flow rate is improved using the balanced state flow model and produces 2 – 4 % higher throughput level in MMTDD mechanism when compared with the VAPR method. The throughput level is computed by summing upon the median flow on each route path in wireless ad-hoc network.

Finally, Median Multicast Throughput Data Delivery mechanism produces higher throughput level on the ad-hoc network. ATS reduce the total median time consumed on transferring the packets from a source path to a destination path in ad-hoc network. MMTDD mechanism concurrently delivers large size of data packets on the multiple paths.

VI. Spatial Time Scheduling Multiple Access Frameworks In Wireless Network

The main objective of the proposed work is to perform effective scheduling by removing the interference and traffic patterns during multicasting in wireless ad-hoc network. Wireless ad-hoc network consists of nodes which move gradually within the network range. The wireless network constructs spatial time scheduler using Resource Median Multicast Routing. The constructed spatial time scheduler is integrated with the Enhanced Genetic Algorithm to control the traffic occurring during the process of multicasting. The architecture diagram of STSMA Framework is described.

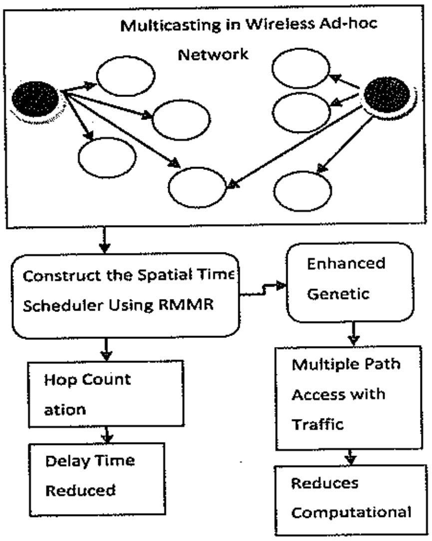

Figure 7 : Architecture Diagram of STSMA

Framework

The framework of STSMA reduces the delay time and computational complexity during multicasting in wireless ad-hoc network while performing the scheduling operations. The goal of STSMA Framework is to optimize multicasting network performance without any interference while developing the scheduling policies. The scheduling operation in the STSMA Framework is carried out in two steps.

6.1. Enhanced Genetic Algorithm for Multicast Traffic Controlling

Enhanced Genetic Algorithm in STSMA framework is used to effectively perform the routing and multicasting in wireless ad-hoc network. Enhanced Genetic Algorithm initially generates the population (i.e.,) multicast routing paths in the wireless ad-hoc network. After the generation of population, spatial time scheduler provides feasible solution with minimal delay time.

6.2. Selection

EGA based STSMA framework selects the subset of a routing (i.e.,) population by generating offspring for the next generation. The enhanced genetic algorithm form of selection is based on ranking for all nodes of the population according to their robustness in the wireless ad-hoc network. The robust nodes are allowed to perform in order to create new nodes for the next generation, whereas the least fit individuals are removed from the routing (i.e., hop count minimization).

6.3.Crossover

EGA based STSMA framework performs the crossover operation in the wireless ad-hoc network from the set of selected nodes during multicasting. STSMA framework ensures that the routing path and time slots are scheduled to the same threshold value in the wireless ad-hoc network (as described in the Eqn (2). The enhanced genetic algorithm schedules the time slot for effective multicasting link formation in wireless ad-hoc network.

6.4. Mutation

EGA based STSMA framework introduce small logical variations to remove the traffic occurrence on the multicasting path in the wireless ad-hoc network. Mutation operation provides the granularity result by logical change in the spatial time slot options. EGA mutation operation leads to an improvement in multicasting by reducing the complexity issue in wireless ad-hoc network.

The algorithmic step description of STSMA framework is defined as,

Input: Wireless network nodes 'N' with multicasting route path

Output: Minimal Delay time, Computational Complexity, Hop Count Minimization

//Spatial Time Scheduler

Step 1: Unassigned Task 'P1', 'P2', 'P3'... 'Pn'

Step 2: RMMR protocol constructs routing

$$R_{s,d1,d2,d3...dn} = \sum s, d1, d2, d3 \ldots dn$$

Step 2.1: Based on the resource constraints

Step3:Spatial Time Scheduler

$G_{sd1.d2....dn} * d_{sd1,d2,d3...dn}(i_1, i_2, i_3 \ldots\ldots i_n)$

Step 3.1: Based on the spatial time options

//Enhanced Genetic Algorithm

Step 4: Selection: Generate offspring to select the route

Ste 5: Crossover: Alternate route path chosen from the wireless network to reduce hop count

Step 6: Mutation: Logical variations to remove the traffic occurrence while multicasting

More precisely, the STSMA framework initialized with a valid routing and the subsequent operations ensures minimal computational complexity. A valid routing in EGA defines a list of multiple intermediate link nodes with the flow's source and ending with the multicasting destination paths in wireless ad-hoc network. The genetic operations are efficiently implemented in the time scheduler process to easily achieve the multicasting in wireless ad-hoc network.

VII. Result Analysis

STSMA Framework performs the simulation and the result is compared with the existing Partially Observable Markov Decision Process (POMDP) and Resource Biasing Approach (RBA). STSMA Framework compares the simulation result through the table and graph on the factors such as traffic control efficiency, scheduling cost, average error rate, packet loss rate, throughput, and delay time.

Table 3 : Tabulation of Traffic Control Efficiency

Traffic Queue Length (meter)	Traffic Control Efficiency (%)		
	POMDP	RBA	STSMA Framework
3	71	81	89
6	77	83	91
9	74	85	94
12	78	86	92
15	80	84	90
18	81	86	92
21	83	87	95

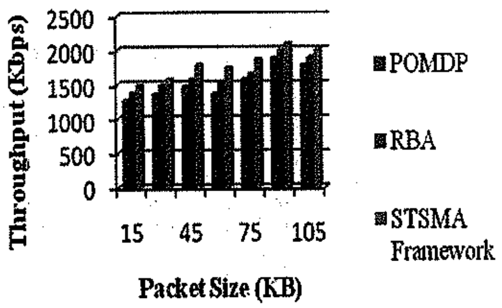

Figure 8: Throughput Measure

The traffic control efficiency based on the traffic queue length. The queue length is measured in terms of meter (m). The interference free result is obtained with the effective controlling of traffic in wireless ad-hoc network with the help of the results of Eqn (3). $\beta_{s,d1,d2,d3..dn}$ indicates the effective multicasting by minimizing the traffic in wireless ad-hoc network with 15 -25 % improved traffic control efficiency in POMDP and 6 - 10 % improved when compared with the RBA .

Table 4 : Scheduling Cost

No.of packets	Scheduling Cost (Measured in terms of milliseconds)		
	POMDP	RBA	STSMA Framework
10	0.31	0.27	0.24
20	0.30	0.26	0.23
30	0.29	0.31	0.27
40	0.27	0.38	0.26
50	0.25	0.40	0.24

The routing easily multicast the information to the different destination addresses within the scheduled time, so the average error rate is reduced in STSMA Framework by 8 – 22 % when compared with the RBA.

Table 5 : Tabulation of Packet Loss Rate

Send Packet Count	Packet Loss Rate (Loss %)		
	POMDP	RBA	STSMA Framework
50	2.65	2.25	2
100	7.12	6.25	5.3
150	10.12	9.12	8.56
200	15.12	13.23	12.12
250	22.01	20.05	18.45
300	20.45	17	15.74
350	25.2	18.85	20

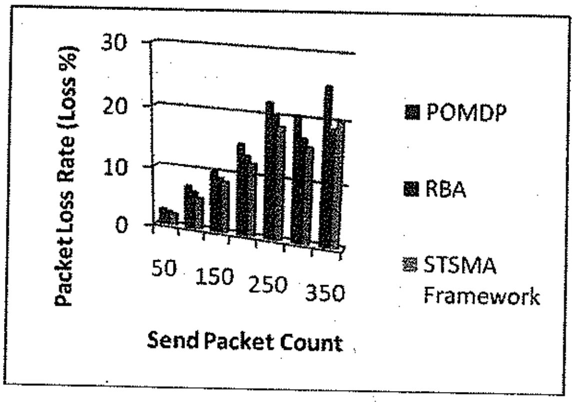

Figure 9: Packet Loss Rate Measure

Describes the packet loss rate based on the packet count sent from the source to the different destination address in the wireless ad-hoc network. Mutation operation in the EGA technique operation provides granularity result by logical change in the spatial time slot options, so that the packet loss rate is reduced. The packet loss rate is reduced from 15 - 25 % when compared with the POMDP and 6 -15% in STSMA Framework when compared with the RBA

Table 6 : Throughput Tabulation

Packet Size (KB)	Throughput (Kbps)		
	POMDP	RBA	STSMA Framework
15	1273	1372	1486
30	1354	1484	1577
45	1474	1571	1791
60	1368	1539	1743
75	1579	1648	1863
90	1882	1990	2092
105	1783	1891	1995
120	2083	2152	2277

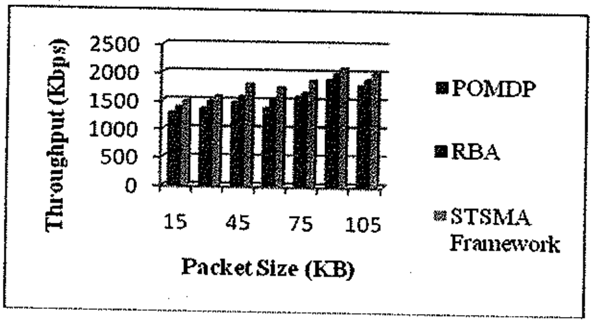

Figure 10: Throughput Measure

Related Work

Single hop traffic was developed in to conduct transmissions simultaneously using the Maximum Weighted Matching (MWM) Scheduling policy to obtain optimal throughput with an enhanced delay performance. The design of distributed algorithms with multi-hop traffic remained an open issue. Minimizing the Queue overflow probability remained the focus in by using an upper bound and with the help of scheduling algorithms to achieve asymptotic decay rate and also maintain queue overflow. Mechanisms to be addressed for smaller queue value remained the focus for the future work.

Scheduling policy using per hop queues were used to prove throughput optimal in network using FIFO model. But problems related to dynamic routing remain unaddressed.

Probabilistic Delta Consistency (PDC) as demonstrated in provided the flexibility on wireless ad-hoc network when compared to the existing reliability scheduling models. The reliability model covered all type of cases in wireless network. But PDC failed to satisfy heterogeneous consistency requirements of diverse form of multicasting and enable cooperation in the midst of caching nodes for successful broadcasting of data updates. Polynomial pool-based key pre-distribution scheme as illustrated in create a pair wise key with the mobile sink. A pair wise key with the mobile sink performed better in terms of network resilience but did not performed multicasting in sensor network.

CSMA-CA scheduling achieved the rate region in wireless network by deriving the neighborhood topology which yielded the worst case throughput ratio

VIII. Conclusion

The spatial time scheduler constructed with the RMMR protocol minimize the hop count and reduces the delay time. The time taken for multicasting is reduced using the STSMA Framework with EGA. EGA performs the selection, crossover, and mutation operations to improve the performance and control the traffic on the multicasting path. The algorithm presented for the STSMA framework performed routing and time scheduling iteratively in order to improve the performance.

The partitioned packets are plotted on the route path using the Averaged Time Standard. The usage of ATS in MMTDD mechanism reduces the time consumption about 7.752 % when compared with the VAPR method. The effective allocation of the data packets also improves the delivery rate of the packets in ad-hoc network. The allocated packets will use the balanced state flow model to sum up the entire flow rate in the wireless ad-hoc network. The ad-hoc network finally derive the general theoretical model by attaining 2.78 % averagely higher throughput level on the multipath packet delivery in ad-hoc network

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