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Higher Throughput Maintenance Using Average Time Standard for Multipath Data Delivery Ad-hoc Network System

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ABSTRACT

Wireless network has come out as one of the key enablers for reliable data delivery for different types of applications.Ad-hoc network consists of self-actuated node that collaborates in order to transfer the information.Trajectory-based Statistical Forwarding (TSF) method used optimal target point selection algorithm to forward packets in order to satisfy probability of packet delivery over multi-hopbut failed provide higher throughputon the multipath data delivery. TheVoid Aware Pressure Routing (VAPR) method used hop count and intensity information to build a directional data delivery system but performance of specialized geographic routing based multipath data delivery was not attained. To maintain the higher throughput level on ad-hoc network data delivery, Median Multicast Throughput Data Delivery (MMTDD) mechanism is proposed in thispaper.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 allocationwith higher throughput level. With the application of ATS, the MMTDD mechanism derives the theoretical model by attainingapproximately 4% higher throughput level on the multipath data delivery in ad-hoc network.MMTDD mechanism makes use of time scheduling schemestodiscover and maintain data delivery paths with minimal time consumption.Median Multicast in MMTDD mechanism used the balanced state flow model to deliver data on multiple paths and experiment is conducted on factors such as time consumption, data delivery rate,average delivery delay and throughput level.

Keywords: Median Multicast Reliable Data Delivery, Ad-hoc Network, Delivery Ratio, Average Time Standard, Time Scheduling, Throughput Level

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1. Introduction

Wireless Ad-hoc network works for the construction ofself organized multipath wireless network. Wireless network obtains all the nodes for forwarding the packets. The presentdevelopment in wireless ad-hoc communication facilitates the devices for performing the process with different transmission rates.The reason for multi-ratecapability stems truthfully from some of the essential properties obtained from wirelessad-hoc communication. The physical outline of the ad-hoc network offersshortestassociationlinking 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 packets.

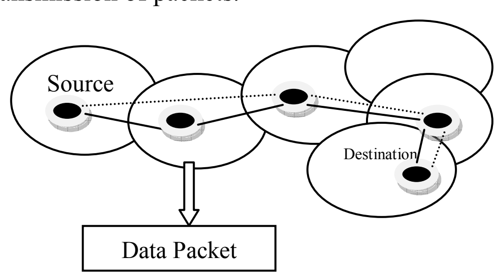

Figure 1 Multipath Data Transmission in Ad-hoc Network

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Figure 1 describes the multipath data transmission in wireless ad-hoc network. The figure illustrates the transmission of packets from the source to the destination using different route paths with the different route paths in ad-hoc network represented through different color shapes. The intrinsic tradeoff occurs between the multipathrouting capabilities of wireless devices. The range speed tradeoff provides the multipath ability to wireless devices for performing the valid routing.

Large number of studies has been conducted on 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 [16] in multi-hop wirelessnetwork with the help of the fixed route selected between each source and destinationpair. 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 channel variations.

Draining life from wireless through Vampire attacks developed with the common properties of protocol module on invalid network path [9]. 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 [11] 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 of 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 [13] 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 pull-based algorithm (DCIM) as illustrated in [10] used adaptive Time to Live (TTL) in order to perform the correct update rates for the data source. With this the 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 the 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 [3]. 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 [6] upholds the reputation of forwarding nodes in wireless network. Reputation protocol composes of acknowledgments, node lists, and aging but did not provide the broadcast communication with minimal delay time.

Probability model in [7] developed the average formula but failed to carry out effective data elivery on packet dropping of different network environments. A statistical forwarding method based on the trajectory (TSF) [1] used the optimal target point selection algorithm. With the introduction of the optimal target point selection algorithm, the vehicle delay distribution and data delay distribution was acquired to offer a dependable, efficient infrastructure-to-vehicle data delivery. Partial deployment of TSF method relay nodes failed to deploy certain number of nodes in order to guarantee the required delivery delay and delivery ratio.

In this work, focus is made on maintaining the higher throughput level during data delivery. In increase the data delivery on multiple paths, Average Time Standard is used to maintain the throughput level. The throughput level is maintained for varying range of data packets with the multipath delivering in the ad-hoc network.With the application of ATS, the total median time consumed isreduced during the packet transferfrom asource path to the destination path in ad-hoc network. TheMMTDD mechanism initially identifies the path and then delivers the data in a timely manner through an inferred bandwidth reservation. As a result, the MMTDD mechanism concurrently delivers data in multiple pathswith large size of data packets.

The structure of this paper is as follows. In Section 1, describes the basic problems inmaintaining the throughput level while transferring the data packets through multiple paths.In Section 2, an overall view of the Median Multicast Throughput Data Delivery (MMTDD) mechanism with Average Time Standard is presented.Section 3 and 4 outline experiment results with parametric factors and present the result graph for research on ad-hoc network multipath data delivery. Finally, Section 5 demonstrates the related work and Section 6 concludes the work with better throughput result outcome in ad-hoc network.

II. Median Multicast Throughput Data Delivery Mechanism 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 in Figure 2.

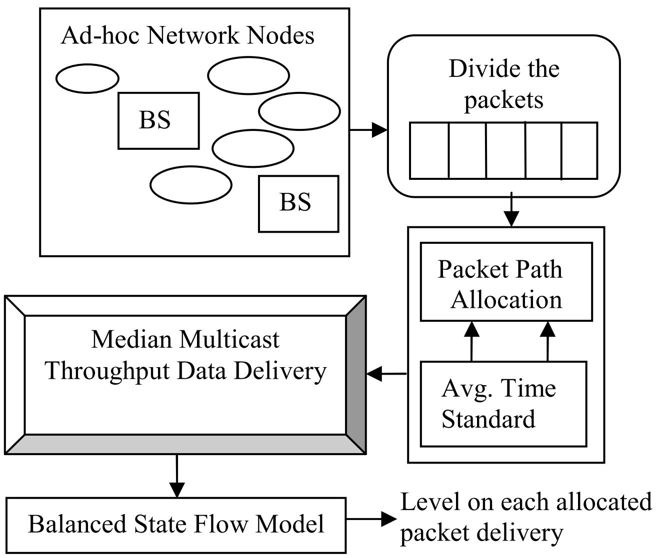

Figure 2Architecture Diagram of MMTDD mechanism

As illustrated in Figure 2,the MMTDD mechanism provides higher throughput level on delivering the packets through multiple paths in wireless ad-hoc network. The construction of multipath route in MMTDD mechanism follows with the network start up, data packet partition, data packet allocation and packet delivery on multipath maintenance. The Initial work in MMTDD mechanism performs the network setup with 1000 ×1000 size with approximately 100 neighboring wireless ad-hoc nodes with the partitioning of nodes using the threshold value.

The partitioned packets are allocated to the ad-hoc network path using the Average Time Standard (ATS). On the other hand, the ATS minimizes the total median time consumed on sending the allocated packets for transmission. The MMTDD mechanism also makes use of time scheduling schemes to discover and maintain data delivery paths with minimal time consumption. The allocated packets now use the Balanced State Flow Model to maintain higher throughput level on multipath data delivery in ad-hoc network.

II.1Data Packet Partitioning

The first process involved in the design of MMTDD mechanism is to partition the data packet.InMMTDD 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 thethreshold value.

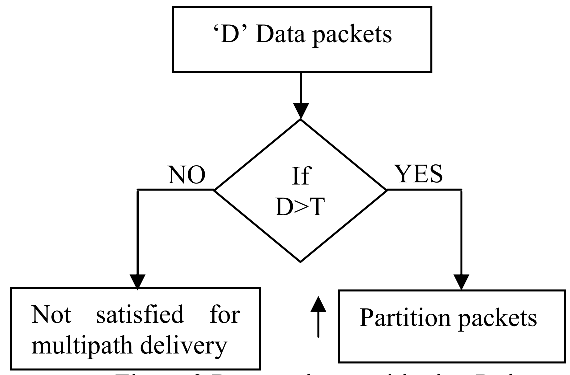

Figure 3 Data packet partitioning Rules

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 partitioningwith 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.

II.2 Allocation of Partitioned Data Packets

Once the data packets are partitioned using the threshold value, the partitioned data packets (D,n) are then allocated to ‘M’ multiple paths in ad-hoc network.In order to allocate the partitioned data packets, MMTDD mechanism, partitioned packets with the criterion such that (D<M). It specifies that in order to perform the allocation, the partitioned data packets ‘D’ should be less than the multiple paths ‘M’ in ad-hoc network. The partitioned data packets are then allocated to minimize the delay count, where delay count > 1/m.As a result, the packet allocation is carried out as,

$$PacketAllocation = n - D + 1 \leq M_i \quad \text{…….. Eqn (1)}$$

The packet allocates the 'n' parts of 'D' data packets in the ad-hoc network with the constraint being measured that the packet partition count does not exceeds the multiple path count in wireless network. The overall allocation of the data packets in the ad-hoc network path is formularized as,

$NetDatapacketAllocation = \sum_{i=1}^{M} n_i = D$ .... Eqn (2)

The ad-hoc network path based data packet allocation is demonstrated in Eqn (2) with the allocated packet on each route follows the Average Time Scheduler. The detailed description of the average time scheduler is discussed in the forthcoming section.

II.3 Average Time Scheduler

The average time scheduler in MMTDD mechanism is mainly used to avoid the packet loss by using the best threshold value for every data packet partitioning. With this the Average Time Scheduler allocate (i.e., larger or smaller) data packets on the ad-hoc network. ATS assigns the load to each link in the ad-hoc network in order to evaluate proportional median time used for sending the packet on the link. The load in the MMTDD mechanism is used to avoid the traffic and congestion path in ad-hoc network.As a result, the ATS still exhibits the advantageous characteristicsthat perform optimal allocation of the packets on the desired route path. The selection of correct route path from multiple paths in ad-hoc network helps to reduce the time consumption in MMTDD mechanism.

The process of ATS is entirely carried out in the ad-hoc network to further perform the processing of packet transmission. The MMTDD mechanism provide the property in handling the large set of 'n' parts of 'D' data packets and also maintains the actual communication path length in ad-hoc network.Subsequently, ATS helps in attaining higher throughput level on the reasonable quantity of median time for allocating the packets.

II.4 Balanced State Flow Model

In MMTDD mechanism, the packet time is scheduledusing 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 packetflows based on the threshold value with the packet flow in MMTDD wireless network defines atransmission graph set.The transmission graph set in MMTDD is defined as TG (V, E, α), where V denotes the nodes in network, E describes the Edges, and α denotes the function that assigns a transmission rate. The transmission rate function is defined as,

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

The function uses the edges which carry the datapackets in ad-hoc network. The maximum flow rate is denoted by D^{+} over edges in MMTDD wireless ad-hoc network.The transmission graph set and the flow rate is improved using the balanced state flow model. This in turn produces higher throughput percentage in MMTDD. The balanced state flow model from the source to the destination on multiple transmission paths is shown in Fig 3.

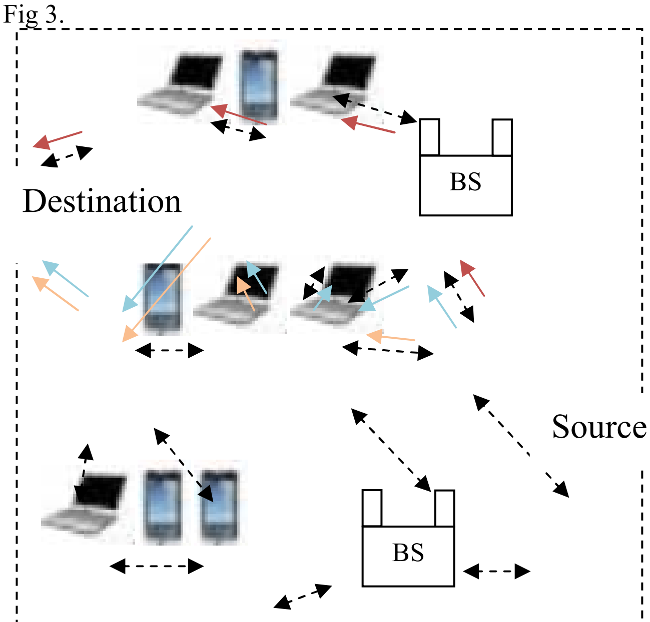

Figure 4 describes the multipath data transmission in wireless network using the Balanced State Flow model. The source node transmits the partitioned packets to the destination using ATS. ATS based packet allocation on the route path helps to transmit the data packets in MMTDD mechanism with higher throughput 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 flowon each route path in ad-hoc network.

$$OverallThroughputlevel = \sum_{i=1}^{M} FR(P1) + FR(P2) + FR(P3) \ldots FR\ (pn)$$

.... Eqn (4)

The overall throughput utilizes the Flow rate 'FR' for each route path 'P1', 'P2', 'P3'.....'Pn'. The flow rate ofthe entiread-hoc network path (i.e.,) multiple pathin balanced state model are summed up together to attain thehigh throughput level averagely.ATS chooses the path based on the partition packet size, so that the

Volume: 6 Issue: 1 Pages: 2176-2183 (2014) ISSN : 0975-0290

packet gets transmitted with minimal time consumption. The packet isallocated 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, α)
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

In MMTDD mechanism, packet delivery is carried out in the ad-hoc network using the balanced state flow model. The balanced state flow model initially set up the network of 1000*1000 for the purpose of simulation. The data packets from the users are taken as the input and the partition work is carried out with the threshold value. The partitioned packets use the ATS to place the packets on the correct route path and also to minimize the time consumption. ATS also helps to improve the data (i.e.,) packet delivery rate by the removing the delay. The avoidance of delay and throughput level improvement in MMTDD mechanism is obtained by computing the flow rate of every route path in ad-hoc network.

III Experimental Evalution Of MMRDD Mechanism

Median Multicast Reliable Data Delivery (MMRDD) mechanism in Wireless Ad-hoc Network is experimented using the ns-2 network simulator. The wireless nodes hold simulation to 20 milliseconds. NS2 simulator uses the random surrounding data path of 1000 ×1000 size with approximately 100 neighboring wireless nodes. The wireless networks continue there for an effective data delivery with qualitative performance.

In the Random Way Point (RWM) model, each wireless node shift to an erratically chosen location. The RWM uses standard number of wireless nodes for multi path transmission. The chosen location with a randomly selected speed contains a predefined amount of speed count. The random progression is constant during the simulation period of wireless sensor network while performing multipath data transmission. Distance Vector Routing (DSR) is performed in wireless network with predefined information with the packet size of 100 Kilo bits per second (Kbps) and movement of wireless node is about 5 Bytes per unit time.

Median Multicast Reliable Data Delivery (MMRDD) mechanism randomly selects the position with a predefined speed. Transmission speed of packet is measured in 2.5 milliseconds (ms). Simulation work is carried out on the factors such as time consumption, data delivery rate, average delivery rate, and throughput level.The time consumption is defined as the amount of time consumed to transfer the data packets through multiple paths in ad-hoc network. The consumption of time is measured in terms of milliseconds (ms) which gives the difference between the first start time at source point (T1) and the end time at destination point (T2).

$$TimeConsumption = T1 - T2$$

The packet 'P' transferred from source to destination with the flow rate is defined as the data delivery rate, measured in terms of speed.

$$DatDeliveryRate = \frac{Data\ (i.e.,)\ packetSize}{Bitrate}$$

The bit rate is assumed to be 10 Mbits/sec. The period of time it delayed to transmit the packet from source to the destination path is termed as the average packet delay. The packet delay is measured in terms of seconds (sec). Throughput on Multi Path (MP) data transmission is the rate at which the successful packet delivered to the destination node over the communication channel. The throughput is usually measured in kilo bits per second (Kbit/s) in the simulation work.

III.1Result AnalysisOf MMRDD

TheMedian 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 table and graph form.

Int. J. Advanced Networking and Applications
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Table 1 Tabulation of Time Consumption

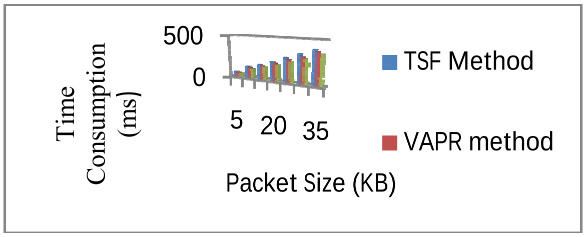

Figure 5 Performance of Time Consumption

Table 1 and Figure 5 illustrate 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 and as a result the proportional median time reduces the time consumption by 10 – 16 % when compared with the TSF Method [1]. 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 [2].

VAPR method	MMRDD mechanism
46.5	49.5
95.1	99
140	146.2
191.5	200
236.4	246.8
290.1	301.2
335.1	349.8

Table 2 Tabulation of Data Delivery Rate

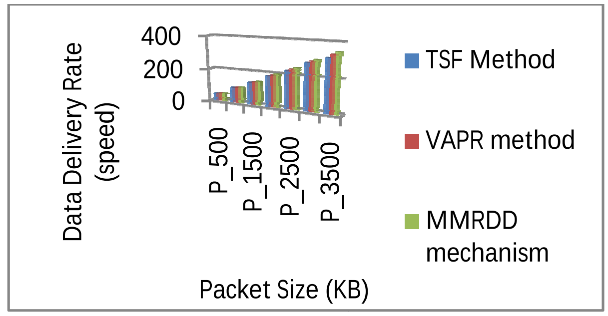

Figure 6 Measure of Data Delivery Rate

Figure 6 illustrates the data delivery rate based on the packet size. As illustrated in the figure, the data delivery rate is improved using the proposed MMRDD mechanism. This is because of the fact that the packet size 'P' uses the base station on ad-hoc network to improve the data delivery rate by 7 – 13 % when compared with the TSF Method [1]. With the application of ATS based packet allocation on the route path, helps to transmit the packets with higher delivery rate. The bit rate is used to easily compute the packet delivery rate in wireless ad-hoc network. With this, theMMTDD mechanism maintains the 3 – 6 % higher data delivery rate when compared with the VAPR method [2].

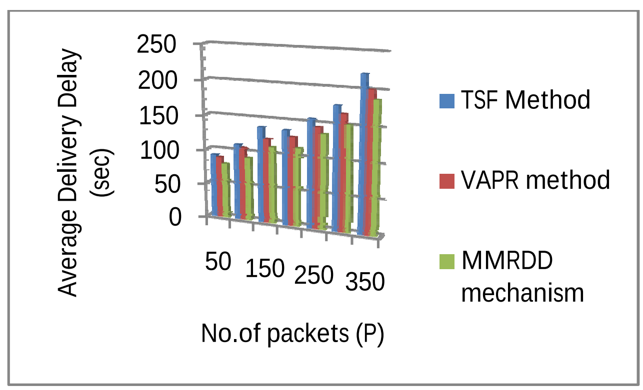

Figure 7Average Delivery Delay Measure

Figure7 describes the average delivery rate based on the packets in ad-hoc network.From the figure it is evident that the average delivery delay is minimized using the proposed MMRDD mechanism. This is because of the fact that the partitioned data packets are allocated to minimize the delay count by 1/m. The overall allocation of the data packets in the ad-hoc network reduces the delay count by 12 -19 % when compared with the TSF Method [1]. The constraint is measured in MMRDD mechanism in such a way that the

Volume: 6 Issue: 1 Pages: 2176-2183 (2014) ISSN : 0975-0290

packet partition count does not exceeds the multiple path count in wireless network, and as a result the delay count is reduced to 6 – 13 % when compared with the VAPR method [2].

Multiple Path Count (MP)	Throughput Rate (Kbps)		
	TSF Method	VAPR method	MMRDD mechanism
MP_2	985	1000	1025
MP_4	1675	1702	1775
MP_6	2315	2398	2456
MP_8	2775	2812	2873
MP_10	3300	3350	3452
MP_12	3582	3605	3689
MP_14	4025	4045	4156
MP_16	4421	4487	4523

Table 4 Throughput Rate Tabulation

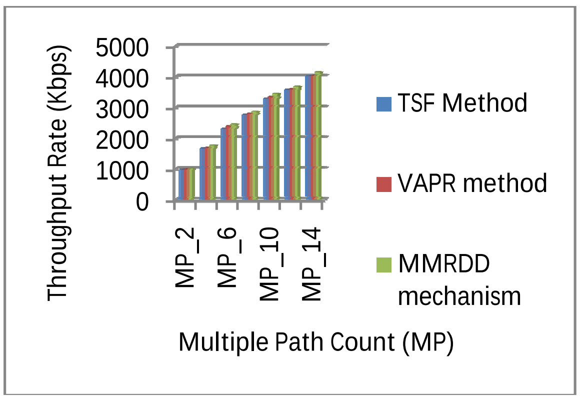

Figure 8Throughput Rate Measure

Figure 8 illustrates 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 [2]. 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.

IV.Related Work

The routing approach Lightweight and Reliable Routing as elaborated in [5] handles two or more events with Information Fusion-based Role Assignment (InFRA) and Shortest Path Tree (SPT) algorithms. But, Lightweight and Reliable Routing failed to balance the overhead and class of routing tree in wireless network. Virtual Destination-based Void Handling (VDVH) scheme as illustrated in [8] performed the communication without any interruption and resulting in the outstanding performance result for higher mobility nodes. But the scheme, VDVH was not satisfied while integrating the data delivery scheme with the security measure. A provable throughput guarantee and achieved upper bounds on end-to-end delay in [14] using joint congestion control and scheduling algorithm.

Single hop [17] traffic was developed in [17] 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 [18] 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 [15] using per hop queues were used to prove throughput optimal in network using FIFO model. But problems related to dynamic routing remain unaddressed. Void Aware Pressure Routing (VAPR) method in [2] used sequence number count hop count and intensity information embedded in intermittent beacons to set up the next-hop direction. VAPR build a directional trail to the closest link but the performance of specialized delivery of geographic routing was not attained. A scattered approach called Localized Multicast for detecting node replication attacks as demonstrated in [4] assessed the competence and effectiveness of geographically limited region. But the protocol is not used in simulation and does not have a more detailed comparison of efficiency based on experiential results.

V.Conclusion

Median Multicast Throughput Data Delivery (MMTDD) mechanism in ad-hoc network maintains the higher throughput level while transmitting data packets from the source to the destination. MMTDD partitions the packet with effective threshold value. 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 packets in ad-hoc network.The allocated packets use the balanced state flow model to sum up the entire flow rate in 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.Simulation work produces efficient data delivery on multiple paths by reducing the average delay.Simulation results demonstrate the importance of communication with higher throughput level in the ad-hoc network design.

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