IJCSC International Journal of Computer Science and Communication Vol. 3, No. 1, January-June 2012, pp. 25-29

H.264/AVC REAL-TIME VIDEO STREAMING IN MANETS

Saleem. Sheik Aalam[1] and T. Arulldoss Albert Victorie[2]

[1]Research Scholar Anna University Technology Coimbatore, India, *E-mail: sheikaalam@gmail.com.*

[2]Asst. Prof. Dept. of .EEE Anna University Technology Coimbatore, India.

ABSTRACT

This paper presents an approach for deriving the streaming of multimedia based data such as video, audio. Packet loss and high delay in MANETs is because of high mobility, limited bandwidth, and congestion. The routing protocols have failed in reducing packet loss and delay while streaming multimedia data at the network layer. All the routing protocols may detect congestion after congestion has happened in the networks. This type of mechanism results in longer End-to-end delay and high packet loss. Especially, video streaming is one of the most successful services demanded by the customers. In video streaming transmission congestion is more probable. Here we present a solution for enhanced video transmission that increases route stability by using an improved route discovery process based on the AOMDV routing protocol, along with congestion control method. We also present a tuning methodology for an H.264/AVC video codec in order to obtain optimal interaction with the underlying mechanisms proposed**.** The simulation results show that our approach will reduce the packet loss rate and end-to-end delay while reducing protocol routing overhead.

Keywords: AOMDV, congestion, MPEG/H.264/AVC, cideo streaming, multimedia.

1. INTRODUCTION

Mobile Ad hoc networks (MANETs) are wireless networks with special characteristics due to the total absence of infrastructure and administrative support. Routing protocols are a key component in MANETs, providing them with their self-configuration and self healing capabilities. These routing protocols endeavour to discover routes, traversing multiple hops, in a highly dynamic environment. The goal of the routing algorithms are reducing the number of hops between source and destination, and several protocols have been successfully adapted to wireless ad hoc networks [1]. On the other hand an alternate routing mechanism is to be to minimize the overall network congestion. Multimedia applications, and more specifically video streaming, are some of the most demanded services nowadays. These kinds of applications need less congestion requirement that must be accomplished to achieve certain level of quality at the customer side. So streaming multimedia is very challenging issue in MMANETs. Many researchers have considered these factors very seriously and are working in this direction [2][3]. Thus, our aim is to develop a routing protocol that provides alternate non congested path if node become congested. The congested node will immediately provide congestion status to concerned node in order to take necessary action. In mobile Ad hoc networks different routing algorithms were proposed but these algorithms are not help to solve the problem at network layer in MANETs. The reactive routing protocols [4] [5], a route is discovered only when there is need for a transmission and released when the transmission no longer needed. Once a link is disconnected it leads delay and overhead due to new route establishment. This type of approach is not suitable for large scale networks. The proactive protocols [6] [7], Even though there is no transmission the routes are established between two nodes and the routing table information is shared to its neighbors periodically. This approach is not suitable for multimedia based large scale networks. Because many unused routes still have to be maintained and the periodic updating may incur overburden to the network. Another approach is multiple paths to the destination may be used as in multipath routing protocols [8]. In multipath routing an alternate available path can be found quickly in case the existing path is broken. For this feature we choose multipath distance vector routing i.e. AOMDV [8] for our proposed approach. In AOMDV to choosing the multiple paths consider only the minimum number of hop counts. In that approach they are not considering the congestion of the each route. If congestion occurs due to high mobility or large amount of traffic in routing, it is immediately detected and corrected by congestion control mechanism. After finding the congestion, it takes time to search new route in severe congestion situation. If new route is needed, many control packets are to be generated to find new route. Even if multipath routing technique is used, it takes some effort to maintain multiple paths. So it leads to high overhead. But in our modified approach is different from the conventional routing protocol.

H.264/MPEG-4 AVC is the latest international video coding standard. It was jointly developed by the Video Coding Experts Group (VCEG) of the ITU-T and the Moving Picture Experts Group (MPEG) of ISO/IEC.

This paper is organized as follows: Section 2 gives the related works for congestion control of the protocols. Our proposed routing design described in section 3. The section 4 gives the overall design of system simulation. The simulation results are discussed in section 5 and conclusions are given in section 6.

2. RELATED WORKS

In Mobile ad network nodes are rapidly changing their nature, congestion is a main factor for more packet loss and longer delay. Traditional AODV is not an effective method under this situation in ad hoc networks [9]. Sheltami [10] evaluates the performance of H.264 protocol using two routing protocols: the Neighbor- Aware Clusterhead (NAC) and the Dynamic Source Routing (DSR) protocols. A dynamic load-aware routing protocol (DLAR) was proposed in [11]. In this protocol a node with low routing load is favored to be included in the routing path during the route discovery phase. A cache-based on demand multipath routing protocol [12] it sends packets on multiple paths simultaneously in a round-robin manner. This is suitable for storage space is available for caching packets, which is not a requirement in our proposed large scale networks. Calafate et al. [13] propose a QoS framework for MANETs combining IEEE 802.11e technology, a multipath routing algorithm, and a distributed admission control algorithm. They obtained a Peak Signal-to-Noise Ratio results under different network congestion conditions. An effective cross layer optimized video streaming algorithm over multi-hop mobile ad hoc networks. Their algorithm attempts to satisfy an end-to-end delay constraint, while maintaining packet loss rate within a tolerable range at the receiver. In CADV [14] is not congestion adaptive, it is a modified version of AODV which favors nodes with short queuing delays to add into the route to the destination and improve the route quality. In [8] the AOMDV protocol provides multi-path capabilities, though route discovery mechanism was proposed. Both node disjoint and link disjoint approaches are presented. In their work there is no congestion control mechanism is proposed.

In this paper we will show how the availability of additional routes, along with the minimum congestion path disjointness to reduce the chances of losing all paths from source to a destination. Such methods prove to be very effective in real time video streaming.

3. PROPOSED ROUTING PROTOCOL

The proposed routing protocol is on the basis of congestion adaptive routing Protocol for real time video streaming in MANETs. Video streaming is the real time application it needs enough resources for transmissions. We have designed this routing protocol based on the requirement of real time applications and have evaluated its performance using ns2 considering different scenarios. Our approach is the extension of AOMDV, the following steps involves determining optimized path for real time applications.

3.1. Estimation of Congestion

The Ad hoc on Demand Distance Vector Routing (AOMDV) protocol is a high performance protocol for MANETs. In this approach, the route discovery process the available paths are identified by minimum number of hops. But this proposed approach is designed to ensure the availability of primary route as well as alternative routes and reduce the route overhead. If congestion happens at any point of time between source and destination nodes on primary route, concerned node warns its previous node about congestion. The previous node uses a non congested alternate route to the destination node. Since video data is very sensitive in delay and packet loss, the measurement of congestion has been considered here depending on average packet delivery time and packet delivery ratio. The congestion status can be estimated in the RREQ by using the average queue length and the response time. Let us we consider the average queue length.

$$E[N_j] = \frac{\rho_j}{1-\rho_j} \tag{1}$$

And the response time $E[R_j] = \dfrac{\rho_j}{\lambda(1-\rho_j)}$ of j nodes.

Where $\rho = \dfrac{\lambda}{\mu}$.

μ = Processing rate & λ = Arrival rate.

If calculated time of the queue length is lesser than the response time, it means the congestion level very low we forward the packets in the network. Even though the queue length equal to the response time we choose the alternate path. And the queue greater than the response time we drop the packets and choose the alternate path.

3.2. Optimal Path Discovery

In the optimal path selection broad cast route request packet (RREQ) to its neighboring nodes. If any node received RREQ packet, it will check present congestion status by using the $E[N_j]$ and $E[R_j]$. The structure of the RREQ packet is shown in the figure 1, whenever the requested destination receives RREQ packet with all satisfied requirements along the way, the destination generates route request packet (RREP) and sends it back. The source node using optimal path based on the RREP information will proceed accordingly. The status of the congestion is high; the path is discarded and sends the information to the source through the RRER message.

3.3. Route Maintenance Process

In route maintenance whenever congestion occurs at any optimal node, will generate Reference packet (RP) and send it to previous node. The RP contains present status of node. If node is suffering from congestion, the congested node send RP packet to its previous node will reduce its transmission rate and forward RP to direction towards source. The intermediate node adjusts their transmission rate and proceeds to transmit in same optimal path instead of selecting alternate path immediately. After receiving the RP the source node adjusts its transmission rate and continues to transmit remaining data. In the worst case the congestion is high; the previous node sends RERR to source and the source proceed to find the alternate path.

destination id	sequence number	hop count	path list
			next hop1, hop-count 1, CS1
			next hop2, hop-count21, CS2 . . .
			expiration timeout

Figure 1: Modified Route Request Format for Video Streaming.

4. PERFORMANCE EVALUATION

The performance evaluation of the proposed protocol was conducted through simulation Analysis using the Ns-2 [15] with the CMU Monarch wireless extensions [16]. We have compared the performance of our proposed approach with AOMDV, AODV routing protocols. The simulations were performed by varying the number of nodes and the mobility of the nodes in the network. The various parameters considered for performance evaluation are discussed in Section 5.1 and the simulation results are described in Section 5.2.

4.1. Performance Metrics

The performance metrics such as throughput, Packet Delivery Ratio, Average End to End Delay and average jitter that were used for the sake of evaluation of our proposed protocol are discussed in this section.

***Throughput*:** It is the number of data packets transferred over a period of time. It is usually measured in bits per second.

Packet Delivery Ratio: It is the ratio of the number of packets received over the number of packets transmitted.

Average End to End Delay: It is the Average Delay in the transmission of packet from source node to destination node.

Normalized Routing Overhead Ratio: The ratio of the total number of routing packets transmitted to the number of data packets delivered.

4.2. Simulation Model

For the simulation model to support video transmission which consists of 100 mobile nodes to form ad hoc network within the 1500m × 800m rectangular field. To test the performance of our proposed routing protocol with other protocols in MANET environment we have used MPEG4/ H.264/AVC video traffic generator [17]. The packet size used in our simulations is 512 bytes and the raw channel bandwidth is 2 Mbps. The ten pairs of source destination flows are randomly chosen to observe congestion. The random waypoint model [18] was used with maximum node speed of 4m/s as suggested in [19]. For each connection, the source generated 512-byte data packets at a constant bit rate (CBR) in the traffic model.

5. RESULTS AND DISCUSSIONS

5.1. Varying Node Mobility

The performance of proposed approach was evaluated by comparing it with AOMDV and AODV. We simulate various numbers of mobility speeds. Figures 1 to 4 show the performance of our approach and the other on demand routing protocols with different node mobility speeds. The proposed routing protocol provide a high packet delivery ratio, small normalized routing overhead, low end-to-end delay and high throughput than AOMDV and AODV. As a consequence, AOMDV has slightly same performance compare to our proposed model but AODV has good variation with our model.

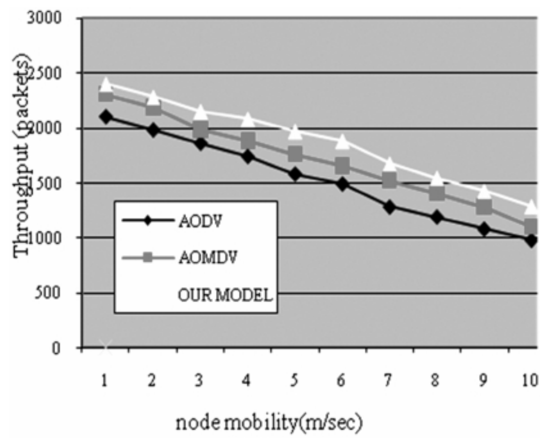

Figure 2: Comparison of Throughput with Varying Node Mobility.

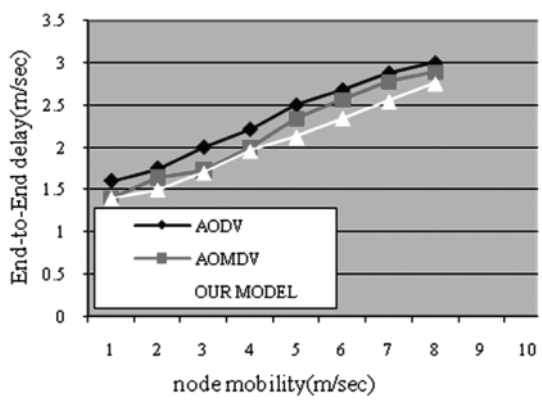

Figure 3: Comparison of End-to-End Delay with Varying Node Mobility.

Figure 2 shows the variation of the throughput with respect to the different node mobility. In our model and the AOMDV performs same. In low mobility range our model 12% outperforms then the AOMDV. In the mid range mobility models we improve 20% than other routing protocols. In high mobility ranges the throughput 10% to 12% improves. Figure 3 shows the end-to-end delay totally our model improves than other routing protocols in all range of mobility speed. The comparison of routing control overhead and packet delivery ratio is shown in figure 4 & figure 5 in low range, the routing control overhead only improves only 5%. In the mid range .i.e. 5 m/sec and 6 m/sec our model outperforms 22% than other routing protocols.

5.2. Varying Number of Connections

We evaluate the network performance in varying nodes. For our simulations we vary the nodes from 10 to 100 with constant node mobility. Figure 5 and figure 6 shows the comparison of the throughput and packet delivery ratio with different nodes. Throughput of our model low and mid ranges more or less same but in higher number of nodes the throughput improves 24%. The packet delivery ratio outperforms AOMDV and AODV. It improves 18% than other routing protocols.

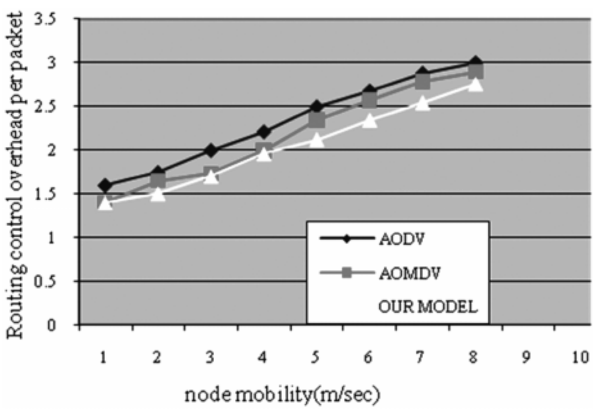

Figure 3(a): Comparison of Routing Overhead with Varying Node Mobility.

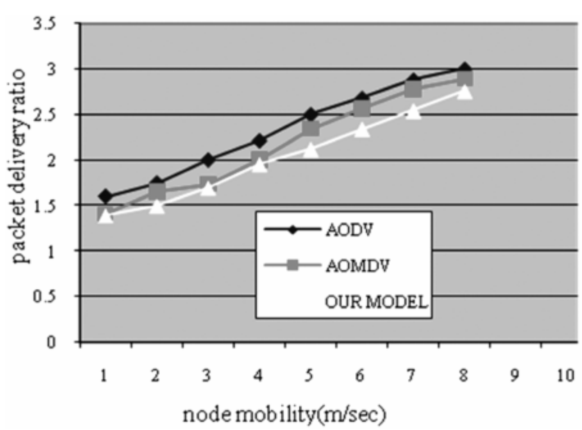

Figure 4: Comparison of Packet Deliver Ratio with Varying Node Mobility.

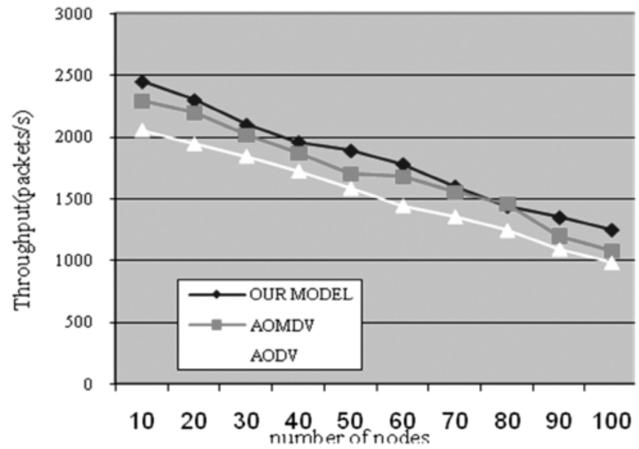

Figure 5: Comparison of Throughput with Varying Number of Nodes.

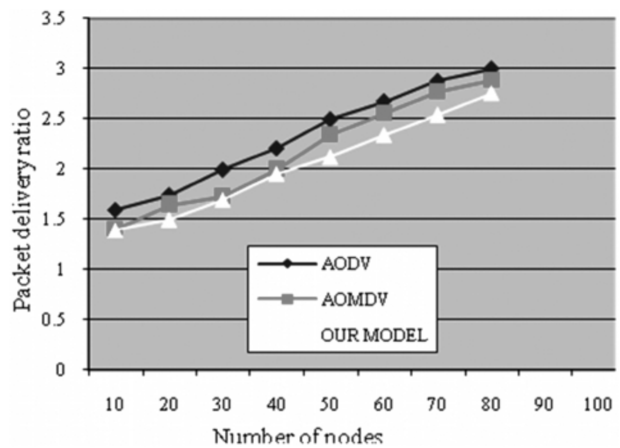

Figure 6: Comparison of Packet Deilivery Ratio with Varying Number of Nodes.

And the figures 7 & 8 show the comparison of end-to-end delay and routing control overhead. In end-to-end delay 24% improves in higher ranges. Routing control overhead is 28% improves than the other routing protocols.

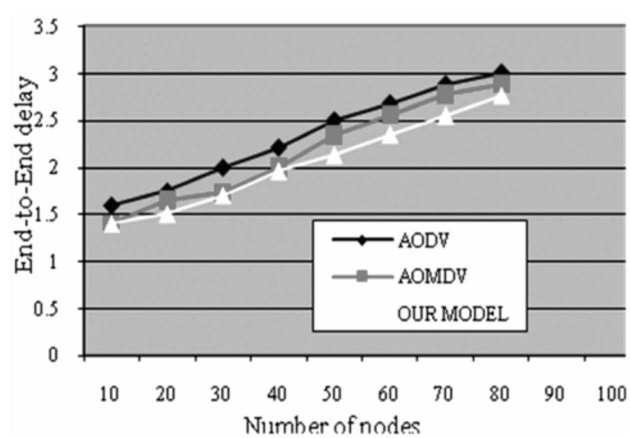

Figure 7: Comparison of End-to-End Delay with Varying Number of Nodes.

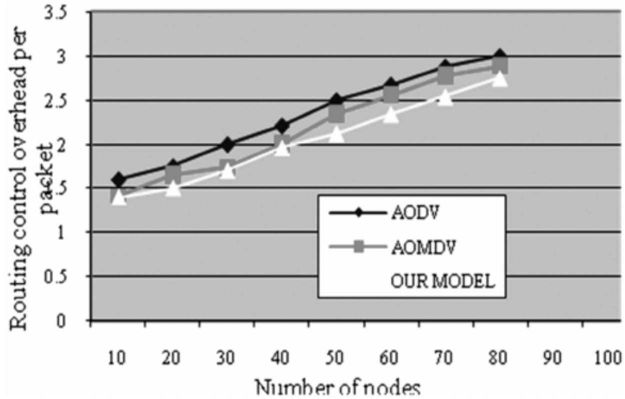

Figure 8: Comparison of Routing Control Overhead with Varying Number of Nodes.

6. CONCLUSION

We have proposed new model that is the extension of the AOMDV congestion Adaptive Routing with support for real time video streaming in Mobile Ad Hoc Networks. Our model tries to prevent congestion by calculating the status of the nodes. The main feature of this approach is the reference packets. The reference packet in our model it indicates the congestion status to the previous nodes. All the intermediate nodes is always aware of present status. If congestion arises at any point of time due to lack of resources, the corresponding node dynamically inform about its status to previous node to take appropriate action. In our model routing overhead is reduced compared to other routing protocols. The proposed approach makes the network less congested compared to other routing protocols. The ns-2-based simulation has confirmed the advantages of the performance of the proposed model, and it is the suitable approach for real time video streaming applications.

REFERENCES

[1] Elizabeth M. Royer and Chai-Keong Toh, "A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks", *IEEE Personal Communications*, pp. 46-55, April 1999.

[2] Lin C. H. Ke, C. H, Shieh C. K., and Hwang W. S. , June 5-7 2006, "A Novel Realistic Simulation Tool for Video Transmission Over Wireless Network", *IEEE* (SUTC2006).

[3] Anthony Lo, Geert Heijenk and Ignas Niemegeers, 2005, "Performance Evaluation of MPEG-4 Video Streaming over UMTS Networks using an Integrated Tool Environment", *International Confernce*, Netherlands.

[4] Perkins C.E. Belding-Royer E.M., and Chakeres I, Oct. 2003,"Ad Hoc On Demand Distance Vector (AODV) Routing", IETF Internet draft,.

[5] Broch J, Johnson D, and Maltz D, Oct. 1999, "The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks", IETF Internet drafts.

[6] Garcia-Luna-Aceves J.J. and Spohn M., 1999, "Source-Tree Routing in Wireless Networks", *Proc. IEEE Int'l Conf. Network Protocols (ICNP)*.

[7] Perkins C.E., 1994, "Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers", *Proc. ACM SIGCOMM*, pp. 234-344.

[8] Marina M and Das S, 2001, "On-Demand Multipath Distance Vector Routing in Ad Hoc Networks", *Proc. IEEE Int'l Conf. Network Protocols (ICNP)*, pp. 14-23.

[9] Y. Lu, W. Wang, Y. Zhong, and B. Bhargava, "Study of Distance Vector Routing Protocols for Mobile Ad Hoc Networks", *Proceedings IEEE International Conference Pervasive Computing and Comm. (PerCom)*, pp. 187-194, March 2003.

[10] Tarek Sheltami, "Performance Evaluation of H.264 Protocol in Ad hoc Networks", *Journal of Mobile Multimedia*, **4**, No. 1, pp. 59-70, 2008.

[11] Lee S.J. and Gerla M., June 2001, "Dynamic Load-Aware Routing in Ad Hoc Networks", *Proc. IEEE Int'l Conf. Comm.*, pp. 3206-3210.

[12] Valera A, Seah W, and Rao S, Apr. 2003., "Cooperative Packet Caching and Shortest Multipath Routing in Mobile Ad Hoc Networks", *Proc. IEEE Infocom*.

[13] C.T. Calafate, M.P. Malumbres, J. Oliver, J.C. Cano, and P. Manzoni, "QoS Support in MANETs: a Modular Architecture Based on the IEEE 802.11e Technology", *IEEE Transactions on Circuits and Systems for Video Technology*, **19**, No. 5, pp. 678-692, May 2009.

[14] Gyeongcheol Lee and Hwangjun Song, "Cross Layer Optimized Video Streaming Based on".

[15] "IEEE 802.11 Multi-Rate Over Multi-Hop Mobile Ad Hoc Networks", *Mob. Netw. Appl.*, **15**, pp. 652-663, October 2010.

[16] http://www.isi.edu/nsnam/ns.

[17] CMU, Oct. 1999, "The CMU Monarch Project: Wireless and Mobility Extensions to ns", http://www.monarch.cs.cmu.edu /cmuns.html.

[18] Gary J. Sullivan, Pankaj Topiwala, and Ajay Luthra, "The H.264/AVC Advanced Video Coding Standard: Overview and Introduction to the Fidelity Range Extensions", *Special Session on Advances in the New Emerging Standard*: H.264/AVC, August, 2004.