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ANALYSIS OF CROSS LAYER BASED MULTICASTING IN MANET

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Abstract

This paper deals with the performance of Cross-Layer based multicast routing approach in MANET to effectively utilize bandwidth and also increase network capacity. Limited resource constraints like Bandwidth and Power in MANETs have lead to the growth of Group-oriented transmissions using Broadcasting and Multicasting. Multicasting is becoming increasingly popular since it can transmit to specific set of hosts in various scattered sub networks. One major challenge is to adapt multicast communication in networks where mobility is unlimited and has resource constraints. The multicast routing protocol is designed by integrating PHY and MAC layer with the NETWORK layer characteristics which will contribute to an improvement of Quality of Service(QoS). In Cross-Layer approach, the routing and data signaling rate is adjusted to the availability of limited resources (residual bandwidth) to achieve the desired level of quality. The proposed scheme presents residual bandwidth estimation, link time prediction and rate adaptation mechanisms. The performance of the proposed Cross Layer approach is simulated using NS-2 to explore its characteristics.

Keywords: *MANET, Crosslayer, QoS, Data rate, Bandwidth.*

1. INTRODUCTION

Mobile Ad hoc networks (MANETs) consist of a collection of wireless mobile nodes which dynamically exchange data among themselves. MANET nodes are typically distinguished by their limited power, processing, and memory resources as well as high degree of mobility. MANETs are autonomously structured with multi-hop wireless links without the aid of infrastructure network. The rapid progress in wireless communication makes MANETs to be used not only for military rescue scenarios but also for industrial and commercial applications. With the expanding range of applications of MANETs, more and more Quality of Service (QoS) sensitive applications, such as streaming media, high bandwidth content distribution, and VoIP, will be or have been deployed in MANETs.

The proposed method examines the QoS issues of multicast routing in MANETs. Multicast routing allows the establishment of multiple paths between a single source and ‘n’ destination nodes. Multicast addressing is employed for the delivery of information to a group of destinations simultaneously using the most efficient strategy to deliver the messages over each link of the network only once, creating copies only when the links to the multiple destinations split. Multicast is typically used to refer to IP Multicast, which is often employed for streaming media and Internet television applications.

QoS refers to resource reservation control mechanisms in order to achieve service quality. The goal is to achieve more deterministic network behavior by proper utilization of the network resources. Quality of service is the ability to provide different priority to applications or data flows, or to guarantee a certain level of performance.The need is increasing in MANETs because the users wishing to use multimedia applications such as video conferencing and live movie streaming require efficient QoS multicast strategies. QoS in MANETs is highly dependent upon routing and

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MAC layer performance. Wireless bandwidth and battery resources must be properly utilized for efficient multicast routing.

2. ROUTING PROTOCOL

Routing is the act of moving information from a source to a destination in an internetwork. The routing concept basically involves, two activities: firstly, determining optimal routing paths and secondly, transferring the information groups (called packets) through an internetwork. Routing protocols use several metrics to calculate the best path for routing the packets to its destination.

Routing protocols that find a path to be followed by data packets from a source node to a destination node used in traditional wired networks cannot be directly applied in ad-hoc wireless networks due to their highly dynamic topology, absence of established infrastructure for centralized administration, bandwidth-constrained wireless links and resource-constrained nodes.

Ad hoc On-demand Distance Vector Routing:

AODV is a reactive protocol i.e. the routes are created only when they are needed. It uses traditional routing tables, one entry per destination, and sequence numbers to determine whether routing information is up-to-date and to prevent routing loops. An important feature of AODV is the maintenance of time-based states in each node, a routing entry not recently used is expired. To find a route to a particular destination node, the source node broadcasts a RREQ to its immediate neighbors as shown in figure 2.1(a). If one of these neighbors has a route to the destination, then it replies back with a RREP. Otherwise the neighbors in turn rebroadcast the request. This continues until the RREQ hits the final destination or a node with a route to the destination. At that point a chain of RREP messages is sent back and the original source node finally has a route to the destination in figure 2.1(b).

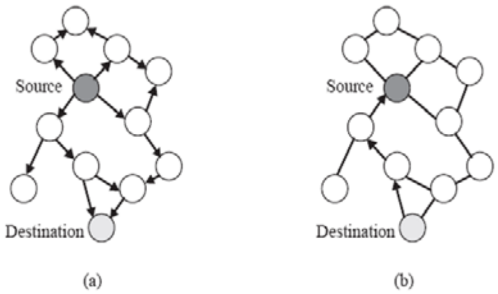

Figure: 2.1 Route discovery in AODV

The AODV protocol never produces routing loops by proving that a combination of sequence numbers and hop counts is monotonic along a route. When a node forwads a route request packet to its neighbours, it also records in its tables the node from which the first copy of the request came. This information is used to construct the reverse path for the route reply packet. AODV uses only symmetric links because the route reply packet follows the reverse path of route request packet. As the route reply packet traverses back to the source, in case if the source moves then it can reinitiate route discovery to the destination. If one of the intermediate nodes move then the moved nodes neighbour realizes the link failure and sends a link failure notification to its upstream neighbours and so on till it reaches the source upon which the source can reinitiate route discovery if needed.

Energy Efficient Ad Hoc on Demand Multipath Distance Vector Routing Protocol:

Energy Efficient AOMDV is a multipath routing protocol that can be designed mainly for highly dynamic energy deficient ad hoc networks where link failure and route break occurs frequently. Each route discovery is associated with high overhead and latency. This inefficiency can

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be avoided by using multipath routing protocol. Four important steps are involved in designing this protocol:

1. Energy Aware selection mechanism
2. Finding the maximal nodal surplus energy along the best paths
3. Sorting the multipath in descending order using the nodal surplus energy
4. Forwarding the data packets through the path with maximal nodal surplus energy.

3. RELATED WORK

Several multicast protocols for multimedia communication in MANETs have been proposed. M-CAMP [9] adopts a measurement-based approach to estimate the bandwidth availability and determine a multicast tree from the server to the clients. Then, probe packets are sent along the multicast tree to test whether the network satisfied the bandwidth requirement. In another work [3], the protocol aims to determine the bandwidth-satisfied multicast tree with the minimal number of forwarders, to reduce bandwidth and power consumption. However, it uses only a single base rate.

The conventional approaches are not sufficient to address the bandwidth and link prediction issues. They also suffer from bandwidth violation problems like Hidden Route Problem (HRP) which occurs due to inconsideration of two-hop neighbors. The data rate adaptability is not available in work [3] to suit the channel conditions. The proposed protocol uses a Cross-Layer based scheme to minimize resource consumption.

4. PROPOSED METHOD

4.1 Cross-Layer Design

Cross-Layer Design (CLD) exploits the dependencies and interactions between layers and has increased the performance in certain scenarios of wireless networking. It shares knowledge about layer state and conditions which has proved to be a promising paradigm for performance optimization in wireless systems.CLD provides knowledge about channel conditions (PHY and MAC) to routing, transport and application layers allowing developers in designing more sophisticated allocation and optimization algorithms. It offers architectural flexibility and QoS support at all the layers.

CLD is fully compatible with existing standards as it does not modify each layer's core function. It is a robust upgrade environment and adding or removing protocols belonging to different layers in the stack is possible without modifying the operations. Cross-Layer also maintains the benefits of modular architecture. The three basic methods in CLD are as follows:

1. Creation of new interfaces
2. Merging of adjacent layers
3. Sharing variables and parameters among multiple layers

4.2 Multicast Protocol

The multicast protocol for data rate selection and bandwidth-satisfied multicast tree determination with an efficient cross-layer design based on the integration of PHY and MAC layers into the network layer. To use bandwidth efficiently and increase network capacity which is the number of multicast flows supported by the network),selection of combination of data rates and a multicast tree whose total amount of bandwidth consumption o the network is minimal in order to maximize the network capacity.

4.2.1 Link Prediction

Link prediction is the predicting links that are about to be broken in order to reduce the likelihood of data packets being dropped. It uses received signal power measurement from physical layer in network layer and performs a route rebuild prior to the link breakage. Location information

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is utilized to estimate the amount of remaining connection time for two neighboring hosts. Link prediction is helpful for the knowledge construction of mobility awareness, and by means of it, stable multicast trees can be determined. A stable tree is a tree that is available for a longer time.

4.2.2 Residual Bandwidth Estimation

The residual bandwidth calculation using the IEEE 802.11 MAC is a challenging problem, because the bandwidth is shared among neighbors, and a host has no knowledge about the traffic status of other neighbors. Moreover, the residual bandwidth of the host and its relation with neighbors vary with the selected rates. The channel is idle if the host is not transmitting/receiving a data/control packet, or does not sense a busy carrier with a signal strength that exceeds a threshold. When a forwarder is transmitting data packets, its neighbors are blocked (i.e., forbidden to send packets).The blocking time can be viewed as the bandwidth consumption to the forwarder and these neighbors. Let i_time_i be the amount of idle time at host during every period time. While determining a tree, the total blocking time induced by the tree to host should be less than i_time_i. So, i_time_i is regarded as the residual bandwidth of host. The residual bandwidth for different rates decreases as the amount of idle time decreases.

Since the bandwidth consumption of the neighbors should be considered for bandwidth-satisfied multicast tree determination, each host v_i maintains two neighbor tables—the one-hop neighbor table and the two-hop neighbor table as shown below:

One-Hop Neighbors	Idle Time	Transmitting SNR Value	Receiving SNR Value	Remaining Connection Time
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
v_j	i_time_j	$t\_snr_{i,j}$	$r\_snr_{j,i}$	$t_{i,j}$
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

Two-Hop Neighbors	Idle Time	Transmitting SNR Value	Remaining Connection Time
.	.	.	.
.	.	.	.
.	.	.	.
v_k	i_time_k	$t\_snr_{j,k}$	$t_{j,k}$
.	.	.	.
.	.	.	.
.	.	.	.

Figure: 4.1 Neighbor tables with SNR & Time values

Let $t\_snr_{i,j}$ denote the SNR value of the channel from v_i to v_j where v_i is the transmitter, $r\_snr_{j,i}$ denote the SNR value of the channel from v_j to v_i where v_i is the receiver, and $t_{i,j}$ is the remaining connection time from v_i, to v_j. The one-hop neighbor table contains five columns for each one-hop neighbor v_j of v_i, and two-hop neighbor table contains four columns for two-hop neighbor v_k of v_i. A link is directed from v_j to v_k if v_k is a one-hop neighbor of v_j.

4.2.3 Data Rate Selection

Rate adaptation is the process of dynamically changing data transmission rate based on the channel quality estimation. If the channel is changing faster than it can be estimated and fed back to the transmitter, adaptive techniques will perform poorly.

The algorithm uses the SNR values obtained by the receivers than using the SNR values which are obtained by the transmitters. The values can be obtained from the one-hop neighbor table (described above) carried by the control/hello packets.

5. SIMULATION AND PERFORMANCE ANALYSIS

Simulation is conducted using Network simulator-2 (ns-2, version 2.27). Each host is equipped with a radio transceiver. The Two Ray Ground model is used to predict the signal power received by the receiver. CBR data traffic flows are injected into the network from the servers and the size of the data payload is 512 bytes.

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Table: 5.1 Simulation Parameters

Simulation Time	100s
Topology Size	1000m x 1000m
Number of Nodes	100
MAC Type	MAC 802.11
Radio Prop Model	Two Ray Model
Radio Prop Range	250m
Pause Time	0s
Max Speed	4m/sec-24m/sec
Initial Energy	100J
Transmit Power	0.4W
Receive Power	0.3W
Traffic Type	CBR
CBR Rate	512 bytes x 6 per sec
No. of Connections	50

The term *Cross layer* is used to denote the proposed algorithm and *Conventional* is used to denote the protocol in which the trees where determined using a single data rate.

Two performance measures namely Throughput and Transmission latency are adopted to evaluate the proposed protocol against the conventional approach.

Throughput

The term throughput is the ratio of the total amount of data that a receiver receives from a sender to a time it takes for receiver to get the last packet.

The data may be delivered over a logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and in data packets per second.

Figure 5.1 Throughput analysis

Fig 5.1 shows the improved throughput of MANET by applying cross layer method by 10% when compared with the conventional method.

Transmission Latency

The transmission latency is the time taken to send a packet from the server to a client through the forwarders of the multicast route. Latency is the average delay that a data packet experiences to cross from source to destination.

This delay includes all possible delays caused by buffering during route discovery delay, queuing at the interface queues and retransmission delays at the MAC, propagation and transfer times.

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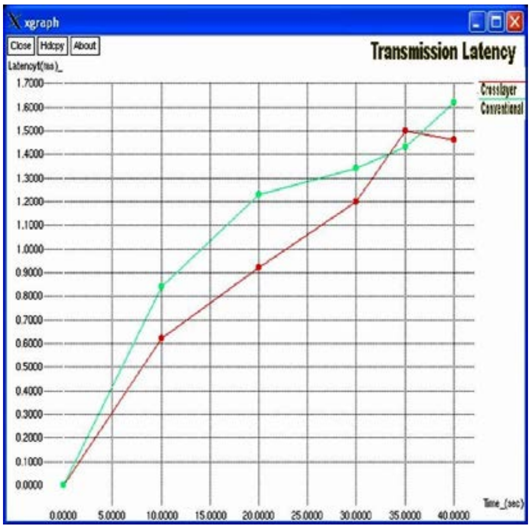

Figure 5.2 Transmission Latency

Fig 5.2 shows the improved delay characteristics in MANET by applying cross layer method by 10% when compared with the conventional method.

6. CONCLUSION

The proposed Cross-Layer Design integrates Physical layer and Medium Access Control (MAC) layer with the Network layer to fully optimize the efficient Bandwidth utilization, Transmission Power consumption and also increase the Network capacity using a combination of the data rates and selection of multicast protocol for minimizing the total block time of the network. Simulation results show the improved Throughput characteristics by 11% and Transmission delay characteristics by 10% by applying cross layered network design approach for a saturated network.

REFERENCES

1. Hu,Chia-Cheng,(2011),'Efficient cross-layer protocol for bandwidth-satisfied multicast in multi-rate MANETs ,Wireless Networks, Kluwer Academic Publishers Hingham, 17(5), pp.739-757.
2. Getsy S Sara, Neelavathy Pari.S, Sridharan.D, (2009),'Energy Efficient Ad Hoc On Demand Multipath Distance Vector Routing Protocol', International Journal of Recent Trends in Engineering, Vol 2(3), pp.10-12.
3. Hu,Chia-Cheng,Wu,E.H.K.,& Chen,G.H. (2008),'Bandwidth satisfied multicast tree in MANETs', IEEE Transactions on Mobile Computing, 7(6), pp.712–723.
4. Chou, C. T., Liu, B. H., & Misra, A. (2007), 'Maximizing broadcast and multicast traffic load through link-rate diversity in wireless mesh networks', Proceedings of the IEEE International Symposium on a World of Wireless, Mobile and MultimediaNetworks,pp.1–12.
5. Ge, W., Zhang, J., & Shen, S. (2007), 'A cross-layer design approach to multicast in wireless networks', IEEE Transactions on Wireless Communications, 6(3), pp. 1063–1071.
6. Chen, L., & Heinzelman, W. (2005), 'QoS-aware routing based on bandwidth estimation for mobile ad hoc networks', IEEE Journal on Selected Areas in Communications, 23(3), (pp.561–572).
7. Gupta, S. K. S., Shankar, V., & Lalwani, S. (2003), 'Reliable multicast MAC protocol for wireless LANs', Proceedings of IEEE ICC pp. 93–97 .Anchorage.
8. Seok, Y., & Choi, Y. (2003), 'Efficient multicast supporting in multi-rate wireless local area networks', Lecture Notes in Computer Science ,pp. 273–283.
9. Pagani, E., & Rossi, G. P. (2001). "A framework for the admission control of QoS multicast traffic in mobile Adhoc networks", Proceedings of the ACM International Workshop on Wireless Mobile Multimedia, pp.3–1.

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