LINK STABILITY BASED MULTIPATH VIDEO TRANSMISSION OVER MANET

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ABSTRACT

Video transport over ad- hoc networks is more challenging than other wireless networks. The wireless links in an ad hoc network are not very much error resilient and can go down frequently because of node mobility, interference, channel fading, and the lack of infrastructure. Moreover, typical video applications may need a higher bandwidth and higher reliability connection than that provided by a single link in current or emerging wireless networks. In Ad-hoc networks connection between source and destination may break down and has to be updated regularly. A path between a source-destination pair is called "stable" if it consists of most stable neighbors at each intermediate hops. Certainly, it is always desirable that any routing protocol picks up more stable paths. Using simulation we can show that our protocol is smart enough to cope with the mobility of the network.

KEYWORDS

ADHOC routing, Broadcast, MANET, Multipath routing, OMNET++.

INTRODUCTION

In this paper, we propose a modified version of popular AODV routing protocol which discovers its route for sending data and video packets separately at different interval of time based on the stability of the path. But we are not mixing both data and video packets. Our aim is to demonstrate video and data packets delivery by identifying paths which are having stability threshold value i.e. stability of the path using SNR & BER. Ad-hoc network is a computer network which uses wireless links for data transmission. This network is called Ad-hoc because other nodes or modules are used to transfer data from source to destination and the connections are built on the fly. MANet (mobile ad-hoc network), a kind of Ad-hoc network, has become a popular subject to the researchers as notebooks and 802.11/Wi-Fi networking have become widespread [1]. The main criterion of Ad-hoc network is that it is structure less and it can configure itself on the fly. So, need for structured network is eliminated. In this modern age, mobile modules (Laptop, Mobile phones, PDA, etc.) have shown great improvement in performance and memory capacity. Large volume of memory can be encapsulated into these gadgets with high processing power. Researchers around the world are exploring possibilities of utilizing these small, mobile and wireless modules to erect a structure-less network of utmost efficiency.

In hostile and rapidly changing environment or on a distant planet, there is no preexistent network system. Then MANet appears as the only tool for communication. At the

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University of Michigan-Dearborn, several faculty members grouped together to form Vehicular Networking Systems Research Laboratory with the intention of performing interdisciplinary experimental research on vehicle-to-vehicle communication and roadside-to-vehicle communication based on ad-hoc network to avoid accidents. A car can get information of whether there is a traffic jam ahead or whether the road is blocked by road works. The driver can then choose alternative path to go. The driver can also be informed of whether a high speed vehicle is coming and thereby avoid accidents. In the roads spiraling around mountains, there is a high tendency of accidents. These phenomena can be avoided by establishing Ad-hoc network among vehicles.

For WLANs, IEEE 802.11 is designed for best effort services. The 802.11 standard specifies two medium access control (MAC) mechanisms: the mandatory distributed coordination function (DCF) and the optional point coordination function (PCF) [3]. The lack of a built-in mechanism for supporting real-time services makes it very difficult to provide QoS guarantees for multimedia applications. To enhance QoS support in 802.11, the IEEE 802.11 working group is currently working on a new standard, known as the IEEE 802.11e, which introduces the so-called hybrid coordination function(HCF). HCF includes two medium access mechanisms: contention- based channel access and controlled channel access (includes polling). Contention-based channel access is referred to as enhanced distributed channel access (EDCA), and controlled channel access is referred as HCF controlled channel access (HCCA).

Although the 802.11e standard has defined QoS-enabled MAC mechanisms, how to apply these mechanisms to different QoS issues is not specified. Among various QoS issues, admission control is an important component for the provision of guaranteed QoS parameters. The purpose of admission control is to limit the amount of traffic admitted into a particular service class so that the QoS of the existing flows will not be degraded, while at the same time the medium resources can be maximally utilized. In this paper we are using video as well as data traffic. So the 802.11e helps in assigning priority to video packets than data packets.

In this paper, we have proposed a modified version of AODV protocol which is based on the concept of "stability" of paths. A neighbor v of a node u, is called "stable" if v's relative movement with respect to u is very low. A path between a source-destination pair is called "stable" if it consists of most stable neighbors at each intermediate hops. Certainly it is always desirable that any routing protocol picks up more stable paths. In this work, our main goal is to mould the existing AODV so that selection of routing path would be smart enough to ensure more efficient transmission of data packets and video packets. Normal AODV protocol chooses the path of shortest delay/hops while sending packets to the destination. But our modified AODV protocol chooses path based on the stability of the path and this protocol can adapt itself dynamically to cope up with the mobility of network. Existing AODV uses "Hello" messages for path maintenance and we utilize these "Hello" messages to measure the stability of routing path. Here we transmit video as well as data packets. Since we are using 802.11e as the underlying MAC layer, it provides priority to video packets than data packets.

Many researchers have given significant contribution to the enhancement of Ad-hoc wireless communication. They have devised several routing protocols to increase the performance of Ad-hoc network. [8] They have designed Enhanced AODV (EAODV) protocol for transmitting video over mobile Ad-hoc network. Their protocol utilizes the stability of the path which is based on signal power received from all other neighbors. They simulated the protocol on network simulator-2 and found favorable results. They showed that EAODV outperforms existing AODV in case of average end to end delay, packet delivery ratio and normalized routing load. [3] The original AODV protocol only finds the routes according to minimum hop count or delay, but in this paper they have modified the original AODV to calculate the stability of the path by using HELLO PACKETS. [9] In this paper route stability is computed based on the received signal strength and inclusion of some extra fields in route request/reply packets. SMQR computes a max 3 node-disjoint paths, and uses the path with max route stability as primary path and the other as secondary path.

1. IDEA ABOUT THE RESEARCH WORK

To find out a stable path between a source-destination pair for sending and receiving video and data packets is the main purpose of this work. When environment is highly mobile many data packets get lost because of collision. Our main target is to implement a stable AODV in order to achieve high performance in the highly mobile environment. With this end in view, we tried to measure nodes movement in a periodic manner so that we can trace out the most stable neighbor. If every node can store the information about the stable neighbor(s), the stable path from a source node to the destination node can be easily detected. AODV sends periodic "HELLO PACKETS" for detecting the neighbor. We utilize this existing feature of original AODV to find out the stable neighbor of each node. Every node periodically observes its neighborhood for some predefined time say δ amount of time and counts number of hello messages received from its neighbors. Based on the statistics such as mobility of the node and link loss, node decides about the most stable neighbor. When a source initiates a route request packet it simply broadcasts the route request to all its neighbors. As in AODV the route request packets are broadcasted but here we are using AODVM (Ad-hoc on demand distance vector multi-path routing) where none of the duplicate RREQ packets are discarded. By this, we find multiple node-disjoint paths from source to the destination. A node receiving this broadcast packet rebroadcast to its neighborhood after appending the stability measure (i.e. the hello count and link loss) between itself and the source of broadcast. This process continues and stability count gets accumulated hop by hop. In this manner when the packet reaches to the destination, the destination gets a measure of stability of paths and can easily determine the most stable path. It just sends out the reply packet through this most stable path (in the reverse order).

2.STABILITY IN MANET

Stability is the quality which asserts the network environment's consistency. In mobile ad hoc network, nodes are continuously moving from one place to another with a certain pause-time. Stability is an important parameter in such an environment. Here comes two types of stabilities Neighbor stability and Path stability. *Neighbor Stability* gives an idea of the neighbor's consistency in the network while *Path stability* gives an idea of the path's consistency from a source node to destination. Neighbor stability helps us to find out the stable neighbor being used as a next hop node. Path stability helps us to use always a stable path for sending packets.

A.NEIGHBOR STABILITY

Here we measure the stability of the path using two parameters
1. Mobility
2. Link loss

Mobility of the path is measured using HELLO packets as follows: Suppose if there are two nodes A and B then the mobility of AB is given as follows

$$Mob_{AB} = \frac{\text{Num of hello packets measured from A to B}}{\text{Num of hello packets measured from B to A}}$$

Link loss of the path is measured by using SNR as follows
Link loss can be measured by using bit error rate which is related to SNR as follows:
Let f be the fading in the channel, given by

$f = P_{tx} / d^2 * k$
where d is the distance between transmitter and receiver.
K is the proportionality constant.
P_{tx} is the Transmitted power.
Assume k=1, simplifying we get,
$f = P_{tx} / d^2$
fading can be also represented as the difference between transmitted and received power.
$f = P_{tx} - P_{rx}$

SNR or signal to noise ratio is given as ratio of transmitted power v/s the noise power. It is given by
$SNR = P_{tx} / N_o$

As channel is fading based, Noise power is the fading power. Hence SNR in db can be represented as:
$SNR = 10 \log_{10} ((P_{tx} / fading)$

In non logarithmic scale
$SNR = P_{tx} / (Ptx - Prx)$

As SNR decreases (when Noise power or fading is more), BER also decreases (More error par transmitted bits). This relationship is represented by following equation.
Hence Bit error rate $P_b \alpha 1/SNR$
$P_b = k/SNR$
$P_b = 1/SNR$ where k=1

B. PATH STABILITY

Similarly, if there are 'n' numbers of nodes then

Mobility of path AD is measured as follows:
Mob of path AD=Mob of AB * Mob of BC * Mob of CD

And the link loss of the path AD is measured as follows:
Link loss of path AD= link loss of AB+ link loss of BC+ link loss of CD

Therefore, by using the two parameters the mobility and link loss, the stability of the path is measured as follows

$$Stability_{path} = \frac{mobility_{path} + link\ loss_{path}}{Number\ of\ hop\ count}$$

3.MODIFIED AODVM

We have applied modification on the existing AODVM protocol by changing selection criterion of routing path. MS-AODVM (More Stable AODV) acts according to existing AODVM in case of sending RREQ and REPLY packets. Even packet formats are almost same. But for the convenience of measuring stability we have added some extra fields in the neighbor management table of the node and in the packets. Forward path and reverse path setup are almost same as existing AODVM with a difference that Forward path setup is delayed.

AODVM is the first modified version of the AODV protocol which is able to detect multiple node-disjoint paths between a sending source and a receiving destination. AODVM is said to be more reliable and to obtain a better overall performance compared to AODV. Additionally to the routing table, RREQ-tables are introduced in AODVM.

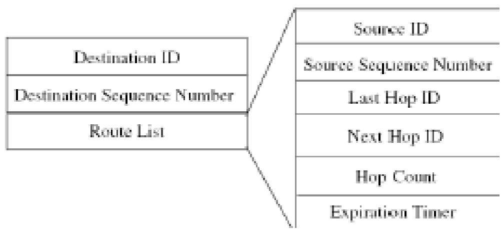

Figure: Routing table in AODVM

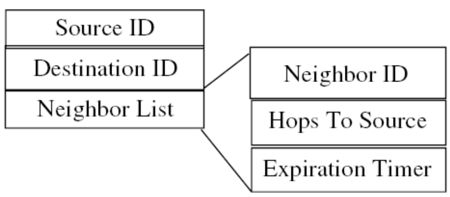

Figure: RREQ table in AODVM

A. Reverse Path Setup

Before sending data packets, AODVM protocol discovers the routing path from source to destination. Source broadcasts RREQ packets to its neighbors and these packets are forwarded from node to node until the desired destination receives this packet. As in the original AODV protocol the duplicate RREQ packets are not discarded by the intermediate nodes. The node forwards packets it updates its routing table as well as its stability table which is used for comparing stability of adjacent links. Thus several reverse paths are created from source to destination. As the RREQ traverses it carries the cumulative value of the stabilities seen so far. So every node adds its stability to the RREQ packet as it forwards the packet.

B. Forward Path Setup

This part is different from existing AODVM protocol. In AODVM protocol the destination sends a RREP message to each of the RREQ which it receives. Along with the RREP message it also sends the calculated stability value of that path. The RREP messages are sent in the reverse path. While sending the route RREP messages through the intermediate nodes, if the neighbouring nodes overhears the RREP messages then that neighbour node deletes the path, which it has in its routing table. By the we ensure that we get node-disjoint paths. The source node waits for some time to receive the RREP messages. After waiting for some amount of time, the source node checks all the stability value of the paths. It starts transmission along the path which has the highest stability value. After selecting the path with highest stability value for transmission, the source node sends an acknowledgement message to the destination, along which it also sends the stability value of the current path which is used for transmission.

HELLO PACKETS are sent at frequent interval of time through the current transmission route. A threshold stability value is maintained which is given by the below formulae

$Stability_{threshold} = avg_{stability} - 20\% \, avg_{stability}$

If the stability value goes below the $stablity_{threshold}$, then a RRER message is sent to the source. The source node will have the next path with high stability value in its cache, which will be used fro transmission. If this route also fails then a new RREQ message is generated by the source.

4.SIMULATION RESULTS

To compare the performance of SAODVM and that of AODV, we have used a detailed simulation based on OMNET++ 3.3. All the settings are applied and visual studio 2005 is also installed. All the nodes are set to wireless node property. The data packets are 512bytes and the video packets are 1024 bytes. The total bandwidth used over here is 11Mbps.the parameters that we are taking to measure the performance of the proposed protocol are pause time, video delivery ratio(VDR), packet delivery ratio(PDR), throughput and node density. Field configuration is set to 350m*350m. here each node starts from a random source and random destination. The mobility model that is used here is random way point mobility model.

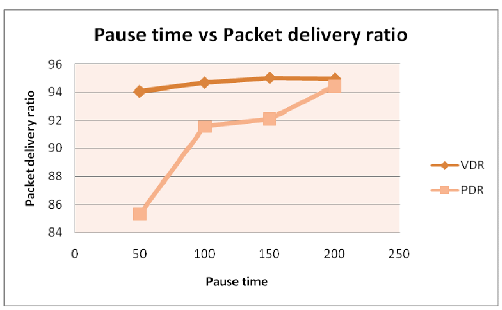

Fig.3: Pause Time vs Packet delivery ratio

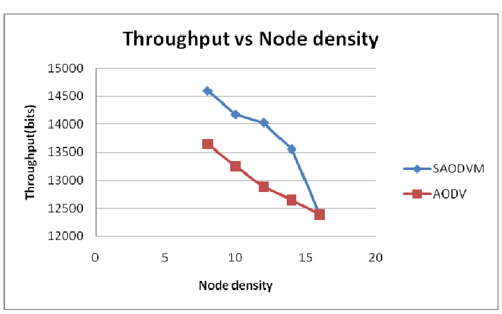

Fig.4: Throughput vs Node density

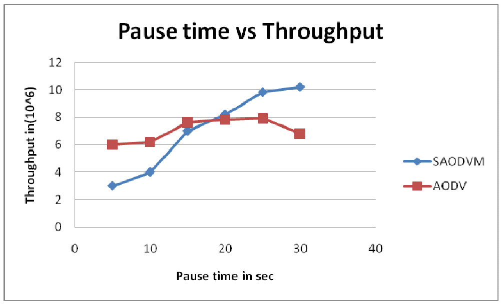

Fig.5: Pause time vs Throughput

Throughout the simulation our main target was to observe the performance of the network in highly mobile environment. As pause time is increased the environment becomes more and more static and SAODVM performs remarkably well in this environment. So we consider only the average mobile environment, that is, when we evaluate the performance metrics we consider 250s as the maximum pause time where total Simulation time is 500s. Fig.5 shows that SAODVM outperforms AODV the most mobile environment and it is the most important thing to consider, because we are trying to establish a stable path from the source to the destination in the mobile environment. Fig.3 shows that the video delivery ratio is more than the packet delivery ratio s we are using 802.11e, which gives higher priority to video than data. Fig.4 shows that the throughput obtained from SAODVM is better when compared to AODV when the nodes density is increasing.

5.CONCLUSION

We have presented a modification of Adhoc On-Demand Distance Vector (AODV) Routing Protocol with the assumption that all nodes will cooperate and no deception is made among neighboring nodes. The modification is solely based on the path stability. We also investigate other mechanisms for measuring stability but path stability seems good to us among all the mechanisms.

We plan to further investigate the proposed model of AODV for multimedia application (Audio data transmission). Quality of Service in MANET field is an attractive issue to the researchers. We envision to make further improvement of our proposed model by considering QoS.

Another possible modification of the proposed algorithm can be considering realistic environment. We have simulated using random waypoint as the mobility model, the other models such as random walk, restricted randomwalk etc can used.

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7.Biography of Authors

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