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Comparison of Routing Protocol in MANETs

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Abstract

AOMDV is widely used protocol these days. But, its permissive for link failure. It takes the necessary action after detecting the link failure thus holding/queuing packets till new route is discovered after detecting failure in existing link.. Early Link Failure Detection-AOMDV (ELFDAOMDV) keeps on monitoring distance between two mobile nodes. As soon distance between two nodes crosses specified threshold then it sends a request to source node to start discovering new route but continues to transfer data packets as the link is still up. In most of the cases, new route is discovered (if some exists) before link failure. Then using the intelligence data packets are automatically shifted to this newly discovered route, thus preventing the link failure. Hence, the algorithm is named as Early Link Failure Detection - AOMDV.

Keywords- Ad hoc networks; Routing protocols; AODV, DSR, AOMDV.

1. INTRODUCTION

In contrast to infrastructure based wireless networks, in ad hoc networks all nodes are mobile are connected dynamically in an arbitrary manner. A collection of mobile host with wireless network interfaces may form a temporary network without the aid of any established infrastructure or centralized administration.

In the case where only two hosts, within the transmission range, are involved in the ad hoc network, no real routing protocol or routing decisions are necessary. But in many practical ad hoc networks, two hosts that wish to communicate may not be close enough within wireless transmission range of each other. These hosts could communicate if other nodes between them participated willfully to forward packets to the destination or the next hop towards the destination. So all nodes behave as routers and take part in discovery and maintenance of routes to other nodes in the network. Route construction should be done with minimum overhead and bandwidth consumption.

1.2 AD-HOC NETWORK DESIGN ISSUES

The Ad Hoc architecture has many benefits, such as self-reconfiguration, ease of deployment, and so on. However, this flexibility and convenience come at a price. Ad hoc wireless networks inherit the traditional problems of wireless communications, such as bandwidth optimization, power control, and transmission quality enhancement, while, in addition, their mobility, multi-hop nature, and the lack of fixed infrastructure create a number of complexities and design issues that are specific to mobile ad hoc networks.

- Infrastructure-less
- Dynamically Changing Network Topologies
- Physical Layer Limitations
- Limited Link Bandwidth and Quality
- Variation in Link and Node Capabilities
- Energy Constrained Operation
- Network Robustness and Reliability
- Network Security
- Network Scalability
- Quality of Service
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2 ROUTING PROTOCOL

Many protocols have been proposed for ad hoc networks, all fall in any of the three sets, namely Table-Driven, Source-Initiated On-Demand, and Zone based.

2.1Table-Driven Routing Protocols

Table-driven routing protocols attempt to maintain consistent, up-to-date routing information from each node to every other node in the network. These protocols require each node to maintain one or more tables to store routing information, and they respond to changes in network topology by propagating updates throughout the network in order to maintain a consistent network view. The areas in which they differ and the number of necessary routing-related tables and the methods by which changes in network structure are broadcast

2.2 Source-Initiated On-Demand Routing

A different approach from table-driven routing is source-initiated on-demand routing. This type of routing creates routes only when desired by the source node. When a node requires a route to a destination, it initiates a route discovery process within the network. This process is completed once a route is found or all possible route permutations have been examined. Once a route has been established, it is maintained by a route maintenance procedure until either the destination becomes inaccessible along every path from the source or until the route is no longer desired.

2.3 Zone Routing Protocol

ZRP divides its network in different zones. That's the nodes local neighborhood. Each node may be within multiple overlapping zones, and each zone may be of a different size. The size of a zone is not determined by geographical measurement. It is given by a radius of length, where the number of hops is the perimeter of the zone. Each node has its own zone.

Advantage

- less control overhead as in a proactive protocol or an on demand protocol
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Disadvantage

- short latency for finding new routes

3 SECURITY IN AD HOC NETWORK

The security needs of Ad Hoc Network are not different from the traditional networks

- Confidentiality
- Availability
- Integrity
- Authentication
- Non-repudiation
- Link Level Security
- Secure Routing

Wireless technologies are unequivocally among the most rapidly progressing technology sectors. There is a vast range of wireless technologies, applications and devices, which are either already a substantial part of our daily life or could play this role in future. Wireless ad hoc networking is one of these applications, which can potentially enhance our abilities to solve real life challenges.

4. ROUTING Protocol Approach

4.1. Adhoc on demand Multi-path distance vector(AOMDV)

Adhoc On-demand Multi-path Distance Vector (AOMDV) [12] is an extension to the AODV. The main difference lies in the number of routes found in each route discovery. A little additional overhead is required for the computation of multiple paths. This protocol does not require any special type of control packets but makes use of AODV control packets with a few extra fields in the packet headers. The AOMDV protocol computes multiple loop-free and link-disjoint paths. There are three phases of the AOMDV protocol. The first phase is the Route Request, second is the Route Reply and the third phase is the Route Maintenance phase.

- **Route Request:**

The protocol propagates RREQ from source towards the destination. Node S as in AODV broadcasts multiple requests to its neighboring nodes 1 and 2. This means that request with same sequence numbers are sent to the destination node. They further broadcast the request to the other neighboring nodes, which are further sent to the destination node D.

- **Route Reply:**

The protocol establishes multiple reverse paths both at intermediate nodes as well as destination. Multiple RREPs traverse these reverse paths back to form multiple forward paths to the destination at the source and intermediate nodes. If the intermediate nodes have the route defined for the destination then they send the RREP to the source node S. The protocol is designed to keep track of multiple routes where the routing entries for each destination contain a list of next hops together with the corresponding hop counts. All the hop counts have the same sequence number then the path with the minimum hop count is selected and all the other paths are discarded. The protocol computes multiple loop-free and link-disjoint paths. Loop-freedom is guaranteed by using a notion of "advertised hop count". Each duplicate route advertisement received by a node defines an alternative path to the destination. To ensure loop freedom, a node only accepts an alternative path to the destination if it has a lower hop count than the advertised hop count for that destination. The advertised hop count is generally the maximum hop count value possible for a node S to reach a node D. If any value that is received by the source S is greater than the advertised hop count value then a loop is formed so this RREP is discarded. The multiple RREPs are received by the source via multiple paths and a minimum hop count route is selected, the other routes carrying a higher hop count value are discarded.

Destination is the node where the packet is destined to, the sequence number to maintain the freshness of the routes, the advertised hop count that avoids the formation of loops. The route list consists of Hop Count required to reach a particular destination, Next Hop is the next hop the packet is supposed to take to reach the required destination, Last Hop is the last hop taken to reach the destination. If the packet is following the same path then this value is same as the Next Hop or else it changes and Expiration Timeout is the time for which the path will exist. There are multiple entries for a single destination but the routes that contain the lowest hop count are only recorded in the routing table and the other routes are discarded.

- **Route Maintenance Phase:**

The third phase is the Route Maintenance Phase. This phase works in exactly same as AODV. If the intermediate nodes are not able to receive a response of the HELLO message then they broadcast a Route Error message. After receiving this message all the nodes that use the particular route to reach the destination make this particular route as infinity and inform the source node to run a fresh route discovery.

There are two types of disjoint paths, one is the node disjoint and the other is the link disjoint. Node-disjoint paths do not have any nodes in common, except the source and destination. The link disjoint paths do not have any common link.

An AODV protocol is been developed which develops route on-demand. The biggest drawback of AODV is with respect to its route maintenance. If a node detects a broken link while attempting to forward the packet to the next hop then it generates a RERR packet that is sent to all sources using the broken link. The source runs a new route discovery after receiving RERR packet. The frequent route breaks cause intermediate nodes to drop packets because no alternate path to destination is available. This reduces overall throughput, packet delivery ratio and increases average end-to-end delay if there is high mobility. The other drawback is that multiple RREP packets are received in response to a single RREQ packet and can lead to heavy control overhead. The HELLO message leads to unnecessary bandwidth consumption.

The AOMDV is an extension to the AODV protocol for computing multiple loop-free and link-disjoint paths. The protocol computes multiple loop-free and link-disjoint paths. Loop-freedom is guaranteed by using a notion of “advertised hop count”. Each duplicate route advertisement received by a node defines an alternative path to the destination. To ensure loop freedom, a node only accepts an alternative path to the destination if it has a lower hop count than the advertised hop count for that destination. With multiple redundant paths available, the protocol switches routes to a different path when an earlier path fails. Thus a new route discovery is avoided. Route discovery is initiated only when all paths to a specific destination fail. For efficiency, only link disjoint paths are computed so that the paths fail independently of each other.

In AOMDV[12] RREQs reaching the node may not be from disjoint paths, if RREQ is from one common node one of the RREQ is discarded, this messages implicitly provide knowledge about the mobility and accessibility of their sender and originator. for example, if node A is constantly receiving messages initiated by another node B, this implies that node B is relatively stationary to node A. furthermore a valid route from node A to node B is available either directly or through other nodes. Instead of discarding repeated RREQs messages node can perform additional computation on available routing data and predict accessibility of other nodes.

Now AOMDV[8] routing make use of pre-computed routes determined during route discovery. These solutions, however, suffer during high mobility because the alternate paths are not actively maintained. Hence, precisely when needed, the routes are often broken. To overcome this problem, we will go for link breakage prediction. Prediction will be done only for multiple paths that are formed during the route discovery process. All the paths are maintained by means of periodic update packets unicast along each path. These update packets are MAC frames which gives the transmitted and received power from which distance can be measured. This distance can be used to predict whether the node is moving inward or outward relative to the previous distance value that is it give the signal strength. At any point of time, only the path with the strongest signal strength is used for data transmission.

4.2. Early Link Failure Detection AOMDV (ELFD-AODV)

AODV is widely used protocol these days. But, its permissive for link failure. It takes the necessary action after detecting the link failure thus holding/queuing packets till new route is discovered after detecting failure in existing link.

ELFD-AOMDV keeps on monitoring distance between two mobile nodes. As soon distance between two nodes crosses specified threshold then it sends a request to source node to start discovering new route but continues to transfer data packets as the link is still up. In most of the cases, new route is discovered (if some exists) before link failure. Then using the intelligence data packets are automatically shifted to this newly discovered route, thus preventing the link failure. Hence, the algorithm is named as Early Link Failure DetectionAOMDV.

Logic to monitor the distance between two mobile nodes-

Source mobile node cannot know the distance till destination mobile node or co-ordinates of destination mobile node. So, source node cannot calculate distance from source to destination. It follows the reverse approach. Algorithm uses the facts that each node knows the current co-ordinates of self. While sending packets source nodes inserts its own co-ordinates in the header. Destination node receives the pakcet containing the source node identification and co-ordinates of source node. Destination node calculates the distance between source and self as it knows its own co-ordinates and co-ordiantes of source node which are received in header. If this distance crosses threshold then destination nodes informs the source node by sending packet that link may break soon. As soon as source node receives such packet, it starts looking for new node.

5. Performance Metrics Comparison

- **Packet Delivery Ratio** – The ratio of total number of data packets successfully received by all the destinations to the total number of data packets generated by all the sources.
- **Throughput:** Throughput is total packets successfully delivered to individual destination over total time.

SIMULATION RESULT AND ANALYSIS

Channel Type Wireless
Radio Propagation Model TwoRayGround
Network interface type Phy/WirelessPhy
MAC type Mac/802_11
Interface Queue Type DropTail/PriQueue
Antenna Type OmniAntenna
Max Queue Length 50
No. Of Mobile nodes 06
Routing protocol-AOMDV/ELFDAOMDV
Mobility Random Way Point Model

Throughput: Measure how soon the receiver is able to get a certain amount of data send by the sender

Throughput in kbps = ((Total size of packets transferred)/(StopTime - StartTime)) * (8/1000)

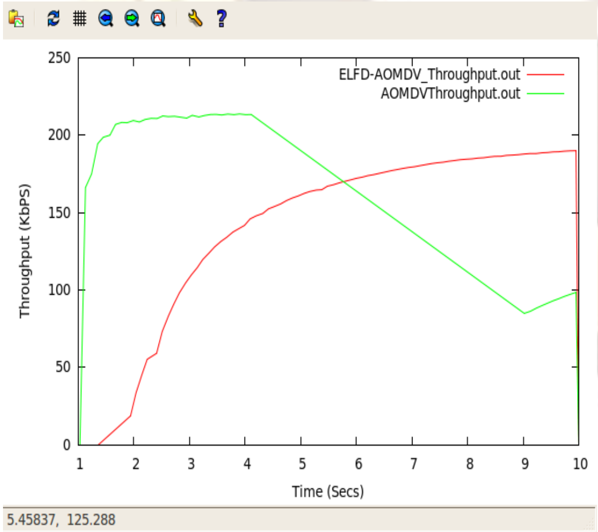

Fig5.1 Throughput ELFD-AOMDV vs AOMDV

- Average throughput of AOMDV== 99.46 kbps
- Average throughtput ELFD-AOMDV ==190.52 Kbps

PACKET DELIVERY RATIO

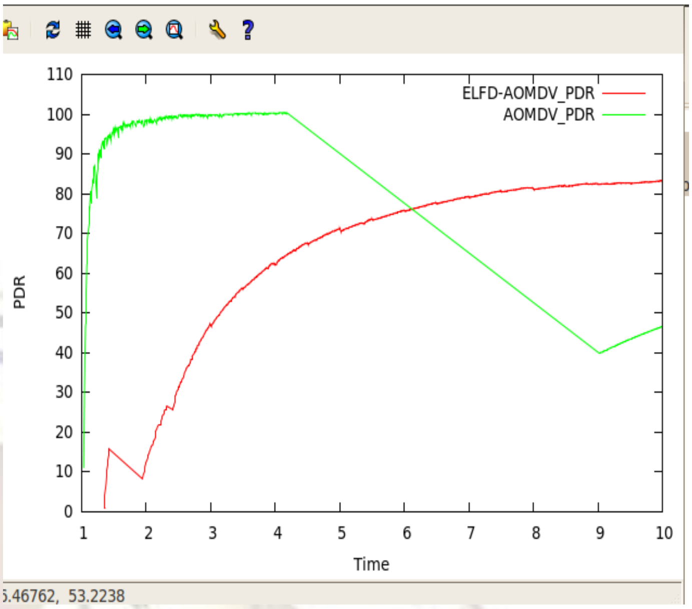

Fig 5.2 Shows Packet Delivery Ratio of ELFD-AOMDV and AOMDV

Packet Delivery Ratio = (No. Of Packets received /No. Of Packets sent) * 100.

- Generated Packets=2400
- Received Packets=1118
- PDR (AOMDV)=46.5833%
- Generated Packets=2572
- Received Packets=2142
- PDR (ELFD-AOMDV)== 83.28%

6 CONCLUSION

In MANETS's due to movement of the nodes, network topology may change rapidly and unpredictably over time. In this decentralized network, discovering the route and delivering of data becomes complicated. In mobility scenario already developed routing algorithms like AOMDV gives degraded results compared to ELFD-AOMDV performance characteristics. ELFD-AOMDV came up with the advantage of Increased Throughput and Packet Delivery Ratio.

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