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The Performance Comparison of an AODV, DSR, DSDV and OLSR Routing Protocols in Mobile Ad-Hoc Networks

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Abstract - **A wireless Ad-hoc network consists of wireless nodes communicating without the need for a centralized administration, in which all nodes potentially contribute to the routing process. A user can move anytime in an ad hoc scenario and, as a result, such a network needs to have routing protocols which can adopt dynamically changing topology. To accomplish this, a number of ad hoc routing protocols have been proposed and implemented, which include Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV) and ad hoc on-demand distance vector (AODV) routing. In this paper, we analyze the performance differentials to compare the above-mentioned commonly used ad hoc network routing protocols. We report the simulation results of three different protocols for wireless ad hoc networks having thirty nodes. The performances of proposed networks are evaluated in terms of number of retransmission attempts, Control traffic sent, Control traffic received, Data Traffic sent, Data Traffic received and throughput with the help of OPNET simulator. Data rate 2Mbps and simulation time 20 minutes were taken. For this above simulation environment, AODV shows better performance over the other two on-demand protocols, that is, DSR and DSDV.**

Index Terms - AODV, DSR, DSDV, OLSR, OPNET, MANET.

I. INTRODUCTION

Wireless networking is an emerging technology that allows users to access information and services electronically, regardless of their geographic position. Wireless networks can be infrastructure networks [1] or infra structure less (Ad-hoc) networks. n Ad-hoc network [2] is a collection of mobile nodes which forms a temporary network without the aid of centralized administration or standard support devices regularly available in conventional networks. These nodes generally have a limited transmission range and, so, each node seeks the assistance of its neighboring nodes in forwarding packets and hence the nodes in an ad-hoc network can act as both routers and hosts, thus a node may forward packets between other nodes as well as run user applications. By nature these types of networks are suitable for situations where either no fixed infrastructure exists or deploying network is not possible. Ad-hoc mobile networks have found many applications in various fields like military, emergency, conferencing and sensor networks. Each of these application areas has their specific requirements for routing protocols. Since the network nodes are mobile, an Ad-hoc network will typically have a dynamic topology which will have profound effects on network characteristics. Network nodes will often be battery powered, which limits the capacity of CPU, memory, and bandwidth. This will require network functions that are resource effective. Furthermore, the wireless (radio) media will also affect the behavior of the network due to fluctuating link bandwidths resulting from relatively high error rates. These unique features pose several new challenges in the design of wireless, ad-hoc networking protocols. Network functions such as routing, address allocation, authentication, and authorization must be designed to cope with a dynamic and volatile network topology. In order to establish routes between nodes which are farther than a single hop, specially configured routing protocols are engaged. The unique feature of these protocols is their ability to trace routes in spite of a dynamic topology. Routing Protocols in Ad-hoc networks can be basically classified as Proactive (table driven) routing protocols and Reactive (on demand) routing protocols [3]. In Proactive routing, routes to all destinations are computed a priori and link states are maintained in node's routing tables in order to compute routes in advance. In order to keep the information up to date, nodes need to update their information periodically. The main advantage of proactive routing is when a source needs to send

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packets to a destination, the route is already available, i.e., there is no latency. The disadvantages of proactive routing are some routes may never be used and dissemination of routing information will consume a lot of the scarce wireless network bandwidth when the link state and network topology change fast. (This is especially true in a wireless Ad-hoc network.) In Reactive routing, protocols update routing information only when a routing requirement is presented. This implies that a route is built only when required. The main advantage of Reactive routing is that the precious bandwidth of wireless Ad-hoc networks is greatly saved. The main disadvantage of Reactive routing is if the topology of networks changes rapidly, a lot of update packets will be generated and disseminated over the network which will use a lot of precious bandwidth, and furthermore, may cause too much fluctuation of routes. In this paper, we present a performance comparison of three important routing protocols for ad hoc networks by varying pause time. In particular, the main goal is the evaluation of the throughput and delay of the routing protocols by focusing on pause time. In this paper we present a number of ways of Classification or Categorization of these routing protocols and did the performance comparison of an AODV, DSR and DSDV routing protocols.

II. MANET ROUTING PROTOCOL

There are different criteria for designing and classifying routing Protocols for wireless ad-hoc networks. For Example, what routing information is exchanged; when and how the routing information is exchanged, when and how routes are computed etc.

DSR: Dynamic Source Routing (DSR) [2] is a reactive protocol i.e. it doesn't use periodic advertisements. It computes the routes when necessary and then maintains them. Source routing is a routing technique in which the sender of a packet determines the complete sequence of nodes through which the packet has to pass; the sender explicitly lists this route in the packet's header, identifying each forwarding "hop" by the address of the next node to which to transmit the packet on its way to the destination host. There are two significant stages in working of DSR: Route Discovery and Route Maintenance. A host initiating a route discovery broadcasts a route request packet which may be received by those hosts within wireless transmission range of it. The route request packet identifies the host, referred to as the target of the route discovery, for which the route is requested. If the route discovery is successful the initiating host receives a route reply packet listing a sequence of network hops through which it may reach the target. In addition to the address of the original initiator of the request and the target of the request, each route request packet contains a route record, in which is accumulated a record of the sequence of hops taken by the route request packet as it is propagated through the network during this route discovery. DSR uses no periodic routing advertisement messages, thereby reducing network bandwidth overhead, particularly during periods when little or no significant host movement is taking place. DSR has a unique advantage by virtue of source routing. As the route is part of the packet itself, routing loops, either short-lived or long-lived, cannot be formed as they can be immediately detected and eliminated.

DSDV: The Destination-Sequenced Distance-Vector (DSDV) Routing Algorithm is based on the idea of the classical Bellman-Ford Routing Algorithm with certain improvements. Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their immediate neighbors. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. There- fore, the update is both time-driven and event-driven. The routing table updates can be sent in two ways: a "full dump" or an incremental update. A full dump sends the full routing table to the neighbors and could span many packets whereas in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. If there is space in the incremental update packet then those entries may be included whose sequence number has changed. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. In a fast-changing net-work, incremental packets can grow big so full dumps will be more frequent. Each route update packet, in addition to the routing table information, also contains a unique sequence number assigned by the transmitter. The route labeled with the highest (i.e. most recent) sequence number is used. If two routes have the same sequence number then the route with the best metric (i.e. shortest route) is used. Based on the history, the stations estimate the settling time of routes. The stations delay the trans-mission of a routing update by settling time to eliminate those updates that would occur if a better route were found very soon.

AODV: AODV offers low network utilization and uses destination sequence number to ensure loop freedom. It is a reactive protocol implying that it requests a route when needed and it does not maintain routes for those nodes that do not actively participate in a communication. An important feature of AODV is that it uses a destination sequence number, which corresponds to a destination node that was requested by a routing sender node. The destination itself provides the number along with the route it has to take to reach from the request sender node up to the destination. If there are multiple routes from a request sender to a destination, the sender takes the route with a higher sequence number. This ensures that the ad hoc network protocol remains loop-free.

Optimized Link State Routing (OLSR): Protocol is a proactive routing protocol where the routes are always immediately available when needed. OLSR is an optimization version of a pure link state protocol in which the topological changes cause the flooding of the topological information to all available hosts in the network. OLSR may optimize the reactivity to topological changes by reducing the maximum time interval for periodic control message transmission. Furthermore, as OLSR continuously maintains routes to all destinations in the network, the protocol is beneficial for traffic patterns where a large subset of nodes are communicating with another large subset of nodes, and where the [source, destination] pairs are changing over time. OLSR protocol is well suited for the application which does not allow the long delays in the transmission of the data packets. The best working environment for OLSR protocol is a dense network, where the most communication is concentrated between a large numbers of nodes. OLSR reduce the control overhead forcing the MPR to propagate the updates of the link state, also the efficiency is gained compared to classical link state protocol when the selected MPR set is as small as possible. But the drawback of this is that it must maintain the routing table for all the possible routes, so there is no difference in small networks, but when the number of the mobile hosts increase, then the overhead from the control messages is also increasing. This constrains the scalability of the OLSR protocol. The OLSR protocol work most efficiently in the dense networks.

III. COMPARISONS

In order to evaluate the performance of ad hoc network routing protocols, the following metrics were considered**:**

3.1. Packet Received vs. Node

The received packets for DSR are much higher than that of DSDV and AODV. The packet received has been calculated by varying the nodes number with respect to a fixed simulation time. Between DSDV and AODV, DSR and OLSR can ensure more successful transfer than the DSDV.

3.2. Throughput vs. Node

DSR shows higher throughput than the DSDV, DSR, OLSR and AODV since its routing overhead is less than others. The rate of packet received for AODV is better than the DSDV.

3.3. Packet Dropped vs. Node

Mainly Packet drop occurs due to the end of TTL (**Time to Live**). If a protocol takes much time to decide destination path, then the packets having short life time, fall into victim to drop. Efficient protocols can wisely find out routing direction thus packets dropping rate reduces for them. The dropped packet for DSR is less than that of DSDV, AODV has no periodic updates exist in DSR.

IV. CONCLUSION

Packet dropping rate for DSR is very less than DSR, OLSR, DSDV and AODV indicating its highest efficiency. Both AODV and DSR perform better under high mobility than DSDV. High mobility occurs due to frequent link failures and the overhead involved in updating all the nodes with the new routing information as in DSDV is much more than that involved in AODV and DSR. In particular, DSR uses source routing and route caches, and does not depend on any periodic or timer-based activities. DSR exploits the cache for route storing and maintains multiple routes per destination. AODV, on the other hand, uses routing tables, one route per destination, and destination sequence numbers, a mechanism to prevent loops and to determine freshness of routes. The general observation from the simulation is that, for applicationoriented metrics such as packet delivery fraction and delay, DSR performs higher than the DSDV and AODV. DSR consistently generates less routing load than AODV.

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