Performance Measurement of Various Routing Protocols in Ad-hoc Network

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Abstract— **An ad hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration. A number of routing protocols like Destination-Sequenced Distance-Vector (DSDV), Adhoc On-Demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR) and Temporally Ordered Routing Algorithm (TORA) have been implemented. In this paper, a comprehensive attempt has been made to compare the performance of two prominent on-demand reactive routing protocols for mobile ad hoc networks: DSR and AODV, along with the traditional proactive DSDV protocol. A simulation model with MAC and physical layer models have been used to study interlayer interactions and their performance implications. The On-demand protocols, AODV and DSR perform better than the table-driven DSDV protocol. Although DSR and AODV share similar on-demand behavior, the differences in the protocol mechanics can lead to significant performance differentials. The performance differentials have been analyzed by varying network load, mobility, and network size.**

Index Terms— **Source Routing, Bellman-Ford Routing Algorithm, Hidden terminal problem.**

I. Introduction

Wireless networking is an emerging technology that allows users to access information and services electronically, regardless of their geographic position. Wireless networks have become increasingly popular in the computing industry. The applications of the adhoc network are vast.

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It is used in areas of Sensor networks for environmental monitoring, Rescue operations in remote areas, Remote construction sites, and Personal area Networking, Emergency operations, Military environments, Civilian environments [2, 3]. The scopes of the adhoc network are also associated with Dynamic topology changes, Bandwidth-constrained, Energy constrained operation, Limited physical security, Mobility-induced packet losses, Limited wireless transmission range, Broadcast nature of the wireless medium, Hidden terminal problem, Packet losses due to transmission errors[2,4,5]. Wireless networks can be classified into two types: Infrastructured and Infrastructure less (Ad hoc) [4]. Infrastructured network consists of a network with fixed and wired gateways. All nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network. In table driven routing protocols, consistent and up-to-date routing information to all nodes is maintained at each node. In On-Demand routing protocols, the routes are created as required. When a source wants to send packet to a destination, it invokes the route discovery mechanisms to find the path to the destination. In recent years, a variety of new routing protocols targeted specifically at this environment have been developed.

II. OVERVIEW OF ADHOC ROUTING PROTOCOLS

A. *Destination-Sequenced Distance-Vector (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. So, the update is b-oth time-driven and event-driven. The routing table update 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 network, incremental packets can grow big so full dumps will be more frequent.

B. Ad Hoc on-Demand Distance Vector Routing (AODV)

AODV adopts a very different mechanism to maintain routing information. It uses traditional routing tables, one entry per destination. This is in contrast to DSR, which can maintain multiple route cache entries for each destination. Without source routing, AODV relies on routing table entries to propagate an RREP back to the source and, subsequently, to route data packets to the destination. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops. All routing packets carry these sequence numbers. An important feature of AODV is the maintenance of timer-based states in each node, regarding utilization of individual routing table entries. A routing table entry is *expired* if not used recently. A set of predecessor nodes is maintained for each routing table entry, indicating the set of neighboring nodes which use that entry to route data packets. These nodes are notified with RERR packets when the next-hop link breaks. Each predecessor node, in turn, forwards the RERR to its own set of predecessors, thus effectively erasing all routes using the broken link. In contrast to DSR, RERR packets in AODV are intended to inform all sources using a link when a failure occurs. Route error propagation in AODV can be visualized conceptually as a tree whose root is the node at the point of failure and all sources using the failed link as the leaves.

C. Dynamic Source Routing (DSR)

The key distinguishing feature of DSR is the use of source routing. That is, the sender knows the complete hop-by-hop route to the destination. These routes are stored in a *route cach*e. The data packets carry the source route in the packet header. When a node in the ad hoc network attempts to send a data packet to a destination for which it does not already know the route, it uses a *route discovery* process to dynamically determine such a route [4]. Route discovery works by flooding the network with *route request* (RREQ) packets. Each node receiving an RREQ rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a *route reply* (RREP) packet that is routed back to the original source. RREQ and RREP packets are also source routed. The RREQ builds up the path traversed across the network. The RREP routes itself back to the source by traversing this path backward. The route carried back by the RREP packet is cached at the source for future use. If any link on a source route is broken, the source node is notified using a *route error* (RERR) packet. The source removes any route using this link from its cache. A new route discovery process must be initiated by the source if this route is still needed. DSR makes very aggressive use of source routing and route caching.

III. EXPERIMENTAL RESULTS AND ANALYSIS

The performance of the protocols depends on various interrelating adhered metrics. The most important parameters ***Packet delivery***, ***Packet dropped*** and ***Throughput*** have been considered herein to draw an analytical observation. ***Packet delivery*****:** The ratio of the data packets successfully delivered to the destination (sink) to those generated by the CBR sources. ***Packet dropped*****:** The ratio of the data packets lost at destinations to those, generated by the CBR sources. It occurs due to the route failure or the overloading of the buffers. ***Throughput*****:** This is the measure of how soon an end user is able to receive data. It is determined as the ratio of the total data received to required propagation time. A higher throughput will directly impact the user's perception of the quality of service (**QoS**).

A. 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, AODV can ensure more successful transfer than the DSDV. The result for the receiving packets has been accumulated in Fig 1.

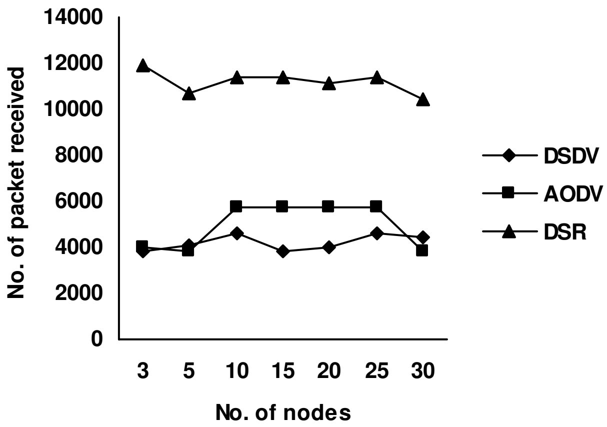

Fig. 1 Packet received for protocols over nodes

B. Throughput vs. Node

DSR shows higher throughput than the DSDV and AODV since its routing overhead is less than others. The rate of packet received for AODV is better than the DSDV. Fig 2 shows the comparison of throughput for the same parameter.

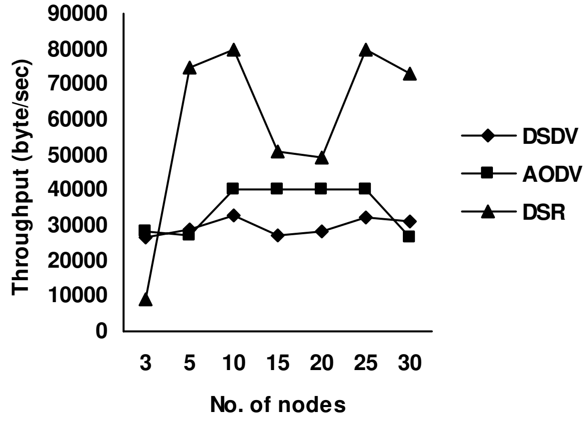

Fig. 2 Throughput of protocols over nodes

C. *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 as no periodic updates exist in DSR.

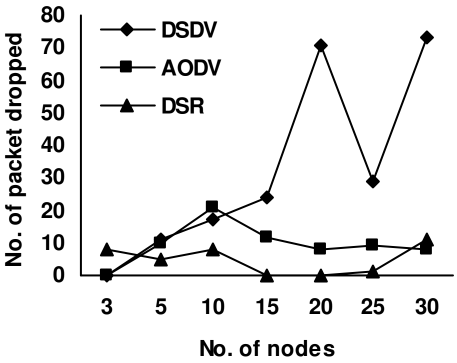

Fig. 3 Packet dropping for protocols over increasing nodes

IV. CONCLUSION

Packet dropping rate for DSR is very less than 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 application-oriented 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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