Comparion of Routing Protocols For Mobile Adhoc Networks

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Abstract

Ad hoc networks are characterized by multihop wireless connectivity, frequently changing network topology and the need for efficient dynamic routing protocols plays an important role.This study is a comparison of three routing protocols proposed for wireless mobile ad-hoc networks.The protocols are: Destination Sequenced Distance Vector (DSDV), Ad-hoc On demand Distance Vector (AODV) and Dynamic Source Routing (DSR). Extensive simulations are made on a scenario where nodes moves randomly.Results are presented as a function of a novel mobility metric designed to reflect the relative speeds of the nodes in a scenario.

Keywords:AODV, DSR,DSDV , Random way point model.

1 Introduction

With recent technological advancement, the wireless and mobile computing devices such as laptops have become increasingly widespread and popular in everyday business and personal life. Often mobile user may meet under circumstances where there is no fixed infrastructure to enable communication among them. In such cases they can form a Mobile Ad hoc Network (MANET) to communicate with each other. A MANET is a collection of wireless mobile host forming a temporary network with out the aid of any centralized administration. Ad hoc network form self organizing architecture that are rapidly deplorable and that are adaptable to propagation condition and to the network traffic and mobility patterns of the network nodes. The most distinguishing characteristics of ad hoc network are the absence of fixed infrastructure. Other characteristics include multihop routing and relatively changing topology. Many Routing Protocols are proposed for MANET have been proposed in the literature.

2 Routing Protocols for MANET

2.1 Adhoc On Demand Distance Vector Routing (DSDV)

DSDV is a table Driven or Proactive Algorithm based on the classical Bellman-Ford algorithm.The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently.
For example the routing table of Node A in this network is

Dest	Next	Metric	Seq
A	A	0	A-550
B	B	1	B-100
C	B	3	C-586

Table 1: routing table of Node A

Naturally the table contains description of all possible paths reachable by node A, along with the next hop, number of hops and sequence number.

Selection of Route:If a router receives new information, then it uses the latest sequence number. If the sequence number is the same as the one already in the table, the route with the better metric is used. Stale entries are those entries that have not been updated for a while. Such entries as well as the routes using those nodes as next hops are deleted.

DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle.Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic networks.

2.2 Dynamic Source Routing (DSR)

Dynamic Source Routing belongs to the class of reactive routing protocol based on the concept of source routing. This protocol allows nodes to dynamically discover a source route across multiple network hops to any destination. Source routing means that each packet in its header carries the complete ordered list of nodes through which the packet must pass. DSR has no periodic routing messages, thereby reduces the network bandwidth overhead, conserving battery power and avoiding large routing updates throughout he ad hoc network. The protocol consists of two major phases: Route Discovery and route Maintenance.

When a mobile node wants to send a packet to its destination, it checks its route cache whether it has any route to the destination. If it has an unexpired route, it will use this route to send packet to the destination. Otherwise, it will initiate a route discovery procedure by broadcasting a route request (RREQ). Each node hears the route request packet, checks whether it knows the route to the destination. If it does not,it adds its own address to the route record of the packet and forwards the packet along its outgoing links of a node, a mobile only forward if the request has not seen by the node and if the node;s address already does not appear in the route record.

A route reply is generated when either the route request reaches the destination itself or an intermediate node which contain in its route cache an unexpired route to destination. If the node generating the route reply is the destination, it places the route record contained in the route request into the route reply. If the responding node is the intermediate node, it will append its cached route to the route record and then generate the route reply. To return the route reply, the responding node must have a route to the initiator.

This protocol uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table-driven approach. In a reactive (on-demand) approach such as this, a route is established only when it is required and hence the need to find routes to all other nodes in the network as required by the table-driven approach is eliminated. The intermediate nodes also utilize the route cache information efficiently to reduce the control overhead. The disadvantage of this protocol is that the route maintenance mechanism does not locally repair a broken link. Stale route cache information could also result in inconsistencies during the route reconstruction phase. The connection setup delay is higher than in table-driven protocols. Even though the protocol performs well in static and low-mobility environments, the performance degrades rapidly with increasing mobility. Also, considerable routing overhead is involved due to the source-routing mechanism employed in DSR. This routing overhead is directly proportional to the path length.

2.3 Destination Sequenced Distance Vector Routing (AODV)

AODV is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad-hoc networks.It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand. In contrast, the most common routing protocols of the Internet are proactive, meaning they find routing paths independently of the usage of the paths. AODV is, as the name indicates, a distance-vector routing protocol. AODV avoids the counting-to-infinity problem of other distance-vector protocols by using sequence numbers on route updates, a technique pioneered by DSDV. AODV is capable of both unicast and multicast routing.

AODV is a reactive strategic protocol that finds routes to a particular destination only when needed and the route is maintained. AODV overwhelms DSR, in reduction of packet header size as it proceeds through the network and in possession of the routing table. AODV follows route discovery and route maintenance phase via route request (RREQ) and route reply (RRLY) messages. The source node floods RREQ and when each node rebroadcasts this request, reverse path pointing to the source is formed such that when an intended destination receives the route request, it replies back by forwarding a RRLY message through the reverse path.

AODV protocol reduces control message overhead and it responds quickly to the changes in network topology. The main drawback is that it the optimal performance is achieved only in low traffic and denser networks.

The main advantage of this protocol is having routes established on demand and that destination sequence numbers are applied to find the latest route to the destination. The connection setup delay is lower. One disadvantage of this protocol is that intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, thereby having stale entries. Also, multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead. Another disadvantage of AODV is unnecessary bandwidth consumption due to periodic beaconing.

2.4 Temporally-Ordered Routing Algorithm (TORA)

The Temporally-Ordered Routing Algorithm is an algorithm for routing data across Wireless Mesh Networks or Mobile ad-hoc networks.

TORA builds and maintains a Directed Acyclic GraphDAG rooted at a destination. No two nodes may have the same height. Information may flow from nodes with higher heights to nodes with lower heights. Information can therefore be thought of as a fluid that may only flow downhill. By maintaining a set of totally-ordered heights at all times, TORA achieves loop-free multipath routing, as information cannot 'flow uphill' and so cross back on itself.

3 SIMULATIONS - RANDOM SCENARIOS

The simulation study was conducted in the Network Simulator(ns2) ,and we use NS2 tools setdest and cbrgen to set the environment.

In the random scenario, we have 50 nodes. each node randomly selects waypoints in a square environment space (1500m x 1500m). At each waypoint a node pauses for a predefined time and picks the speed to the next waypoint from a uniformly distributed interval [0..Vmax].

We use the Scenario file to describe the movement pattern of the nodes and the communication file to describe the traffic in network. These files are used for the simulation and as a result trace file is generated as output. Pror to the simulation the parameters that are going to be traced during the simulation must be selected. The trace file be scanned and analyzed for various parameters that we want to measure. This can be used as data for plots with.The parameter specification shown in the flowing table 2.

Parameter	Value
Simulation time	250s
nodes	50
Map size	1500mx1500m
Max speed	20m/s
Mobility model	Random way point
Traffic Type	Constant bit rate (CBR)
Packet Size	512 bytes
Connection rate	4pkts/sec
Pause time	0,20,40,60,80,100

Table 2: Transmission Parameters

Simulation code:

```
set val(chan) Channel/WirelessChannel
set val(prop) Propagation/TwoRayGround
set val(ant) Antenna/OmniAntenna
set val(ll) LL
set val(ifq) Queue/DropTail/PriQueue
set val(ifqlen) 50
set val(netif) Phy/WirelessPhy
set val(mac) Mac/802_11
set val(nn) 50
set val(rp) AODV
set val(x) 1200
set val(y) 1200
set ns_ [new Simulator]
set topo [new Topography]
$topo load_flatgrid $val(x) $val(y)
set god_ [create-god $val(nn)]
set chan [new $val(chan)]
set f [open aodv1_0.tr w]
$ns_ trace-all $f
set namtrace [open aodv1_0.nam w]
$ns_ namtrace-all-wireless $namtrace $val(x) $val(y)
$ns_ node-config -adhocRouting $val(rp)
  -llType $val(ll)
  -macType $val(mac)
  -ifqType $val(ifq)
  -ifqLen $val(ifqlen)
  -antType $val(ant)
  -propType $val(prop)
  -phyType $val(netif)
  -topoInstance $topo
  -agentTrace OFF
  -routerTrace OFF
  -macTrace ON
  -movementTrace OFF
  -channel $chan
for set i 0 {$i¡$val(nn)} {incr i} {
set node_($i) [$ns_ node]
$node_($i) random-motion 1}
source"scene_3p"
source "cbr_50"
for set i 0 {$i<$val(nn)} {incr i} {
$ns_ initial_node_pos $node_($i) 10 }
proc finish {} {
  global ns_ f namtrace
  $ns_ flush-trace
  close $namtrace
  close $f
  exit 0}
$ns_ at 200.0 "$ns_ nam-end-wireless 200.0"
$ns_ at 200.0 "finish"
puts "Starting Simulation..."
$ns_ run
```

Performance metrics: The following 3 quantitative metrics are used to assess the performance:

1.Packet delivery ratio: The ratio of the data packets delivered to the destinations to the data sent out by the sources.

2.Average end-to-end delay: This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue,retransmission delays at the MAC, and propagation and transfer times.

3.routing overhead:refer to the total number of all routing overhead control group.

Results and Discussions

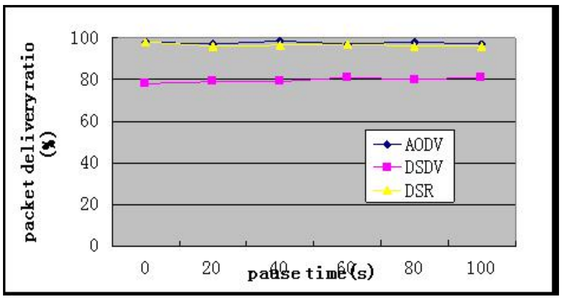

Figure 1: Packet delivery ratio

First we analyze the first parameter Packet delivery ratio with respect varied pause times. When the pause time increase from 0 to 100s, the packet delivery ratios of the three routing protocols remain stable.The Figure1 shows that the packet delivery ratio for the two on-demand routing protocol AODV and DSDV is similar. And the packet delivery ratio for DSDV is lower.

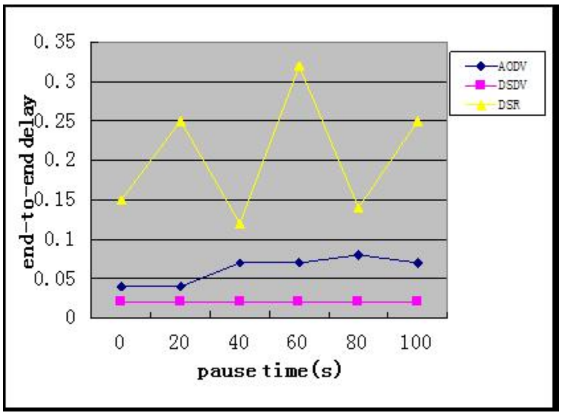

Figure 2: End-to-end delay

For the second parameter end-to-end delay, the DSR has highest delay with respect varied pause times. AODV followed. The DSDV is lowest.When the pause time increases, the DSR delay changes rapidly, the AODV delay has a slowly increasing trend,and the delay of DSDV is stable.

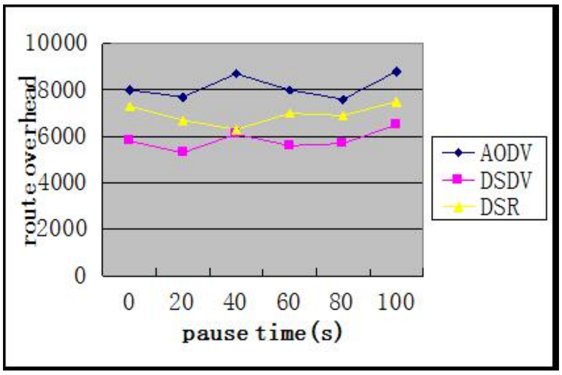

Figure 3: Route overhead

The third parameter Normalized routing load with varied pause times is analyzed and it is found that for DSR it is less when compared to AODV and we see that it is fairly stable A relatively stable normalizes routing load is a desirable property for scalability of the protocols. We find that major contribution to AODV routing overhead is from route requests, while route replies constitute a large fraction of DSR routing overhead. By virtue of aggressive caching, DSR is more likely to find the route in the cache and hence the route discovery process occurs less frequently than AODV and hence the routing overhead for DSR is less when compared to AODV. And DSDV has a relatively small route overhead as a table driven protocol.

Conclusions

DSR and AODV both use on-demand route discovery, but with different routing mechanics. In particular, DSR uses source routing and route caches, and does not depend on any periodic or timer-based activities. DSR exploits caching aggressively 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. AODV, outperforms DSR in more stressful situations with widening performance gaps with increasing stress (e.g. higher mobility). DSR, however, consistently generates less routing load than AODV. The poor performances of DSR are mainly attributed to aggressive use of caching, and lack of any mechanism to expire stale routes or determine the freshness of routes when multiple choices are available.

DSDV are more suitable for small networks where changs in the topology are limited. Also DSDV could be considered for delay constraint network. DSR is suitable for networks in which the nodes move at moderate speed. AODV in the simulation has the stablest all around performance.It is the improvement on DSDV and DSR and has the advantage of both of them.