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COMPARATIVE STUDY OF AODV AND TORA ROUTING PROTOCOLS IN MANET

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Abstract- Mobile Ad-hoc network (MANET) is a collection of mobile nodes communicating with each other through wireless network. Because the connectivity among the nodes may vary with time due to node departures, node mobility and new node arrivals generally the network topology is Dynamic. For node communication there is the need for Routing protocols. There are number of protocols in MANET this paper deals with study of two important routing protocols in MANET namely Ad Hoc On- demand distance Vector Routing (AODV) and Temporally Ordered Routing Algorithm (TORA).
Keywords- Temporally Ordered Routing Algorithm (TORA), Packet Delivery Ratio, Ad Hoc On-Demand Distance Vector Routing (AODV).

1. INTRODUCTION

In Mobile Ad hoc network there is a collection of several independent mobile nodes which communicate with each other using radio waves .When two nodes are placed in same transmission zone they communicate directly with each other in point-to-point mode, while communication with a node in another zone is carried out via several intermediary nodes in multi-hop mode[1]. Each node in the network acts as both host and router. It discovers and maintains routes to other nodes in the network. Sometimes due to environmental calamities the existing infrastructure may be destroyed in such situations MANET can be very useful for military, disaster recovery etc. Since, in MANET nodes are mobile, network topology may change unpredictably and connectivity among the terminals may vary with time. So there is the need for efficient routing protocol to cope up with such dynamic network conditions.

2. TYPES OF ROUTING IN AD HOC NETWORK

For MANET number of routing protocols and algorithms have been proposed and closely studied over fast few years. One of the most popular methods to distinguish mobile Ad hoc network routing protocols is based on how routing information acquired and maintained by mobile nodes.

In this approach a mobile node uses its knowledge about recent connectivity of the network including the state of network links[2].Routing protocol are classified into three categories based time at which the routes are discovered and updated.

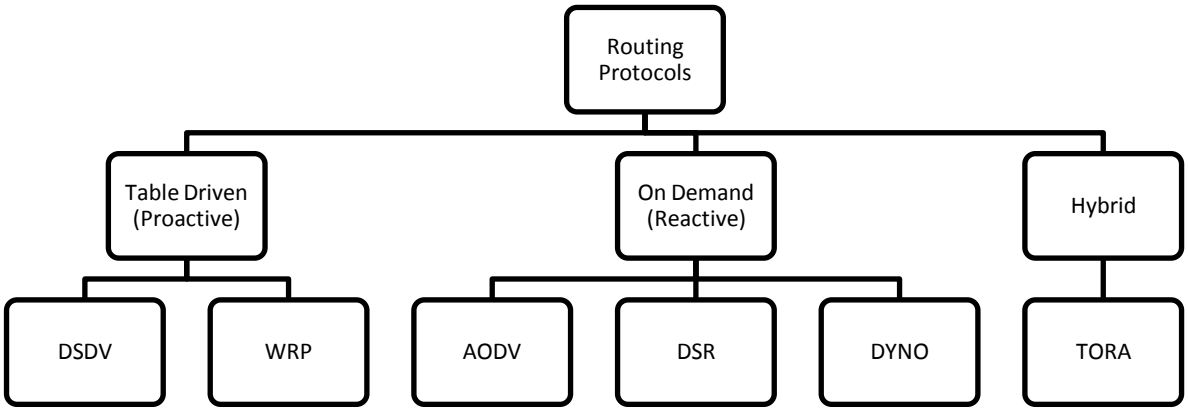

Figure 1. Categories of Routing protocols in MANET

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2.1 Proactive Routing Protocols

In proactive protocols all routing information is maintained in tables so it's also known also "table driven "approach. In this approach nodes in the network regularly discover path to all nodes which are reachable and all the routing information is consistent and up-to-date and everything will be stored in the routing table. . This makes it easier for a source node to get a routing path immediately when required [1].In set interval of time the routing tables will be periodically exchanged between nodes .Routing updates occur at specified time intervals no matter whatever may be the mobility and traffic characteristics of the network.

2.2 Reactive Routing Protocol

In this approach a node does not continuously maintain a route between all pairs of network nodes. Only when nodes are actually needed they are discovered. Here, first node checks its route table to know whether it has a route, before it has to send data to some destination. If there is no route in the table, then node will find a path to the destination this procedure is called as route discovery procedure. Hence, only on- demand route discovery is done. This approach is therefore also called as on-demand routing.

2.3 Hybrid Routing Protocol

This protocols are the combination of both proactive and reactive hence it is called as hybrid routing protocol.Nodes within a particular geographical region or within certain distance from the node concerned are said to be within routing zone. Table driven approach is used for routing within this zone.For nodes that are located beyond this zone, an on-demand approach is used.

3. MANET ROUNTING PROTOCOLS

In our study we mainly focused on reactive and hybrid protocol such as AdHoc On-Demand Distance Vector Routing (AODV)**,** Temporally Ordered Routing Algorithm (TORA).

3.1 Adhoc on demand distance vector

AODV is reactive protocol in this kind of protocol node discovery or maintenance is not done unless there is a request bythe nodes. To ensure loop freedom and freshness of route [3] AODV uses destination sequence number .AODV has an ability to perform routing in both unicast and multicast way. There are mainly 2 operational functions in this protocol namely route discovery and route maintenance. Route discovery mechanism begins only when node requests to communicate with another node. First source node sends route request message to its neighboring nodes and neighboring nodes forward this information to its neighboring nodes and this process continues until route request message RREQ reaches the destination node. The initiator of RREQ message receives a route reply message RREP by the node which has the information of the destination node. The path which will be recorded in intermediate nodes in the routing tables identifies the route. Initiator can start sending the packets once it receives route reply message. When the link with next hop breaks a route error RRER is reported.

3.2. Temporally Ordered Routing Algorithm (TORA)

The Temporally Ordered Routing Algorithm (TORA) is mainly based on link reversal proposed by Park and Corson[4]. It's a hybrid protocol.Using "flat" non-hierarchical routing algorithm TORA achieves a high degree of scalability. To establish a direct acyclic graph and the length of the route that physically (DAG) rooted at the destination TORA uses an arbitrary height metric. There may exist multiple routes to given destination but all of them are not necessarily the shortest route.TORA algorithms maintains the direction of the next destination to forward the packets instead of depending on shortest path for computing the routes. In TORA nodes have to query for path only when it needs to send a packet to a destination, by this TORA reduces the control messages in the network. Mainly TORA has 3 phases. i) Route Creation, ii) Route Maintenance and ii) Erasure of invalid routes.

In TORA nodes mainly use height metric to establish a directed acyclic graph (DAG) rooted at destination[5]. Based on relative height metric of neighboring nodes links are assigned. Due to mobility DAG is broken several times, during this period route maintenance unit comes into picture to reestablish a DAG routed at the destination.

In initial stages before creating the route the node broadcasts a QUERY packet to its neighbors. Until it reaches the destination node this QUERY is re-broadcasted through the network. Then later on UPDATE packet will be broadcasted by recipient of the QUERY which lists its height with respect to the destination. Once this packet start propagating in the network, node that receives UPDATE packet will set its height to a value greater than the height of the neighbor from which the UPDATE was sent. Nodes will adjust its height so that it will be a local maximum with respect to its neighbors and then transmits the UPDATE packet when it discovers that route to the destination is no longer valid. New route discovery will be done if the node finds that no node in its neighboring has the finite height with respect to the destination. For resetting of routing over ad hoc network CLEAR packets are generated when node detects a network partition. Since in TORA routing is based on DAG mechanism all the routes will be loop free. Here top-down approach has been followed since packets move from node having the highest height to the destination node with the lowest height.

Advantages[5]

- Since TORA strongly support multiple routes between that of source and destination removal of any of the nodes are quickly resolved without source node intervention.
- TORA does not require a periodic update.
- In order to control packet delivery and security authentication TORA provides the supports of link status sensing and neighbor delivery.

Disadvantages:

- TORA mainly depends on synchronized clocks among the nodes in the ad hoc network.
- The dependence of this protocol on intermediate lower layers for certain functionality presumes that the link status sensing, neighbor discovery, in order packet delivery and address resolution are all readily available. This solution is to run the Internet MANET Encapsulation Protocol at the layer immediately below TORA.
- This will make the overhead for this protocol difficult to separate from that imposed by the lower layer.

4. PERFORMANCE METRICS

The routing algorithms were evaluated using following four performance metrics[6].

4.1 Packet Delivery Ratio (PDR) –

PDR is the ratio of difference between total number of generated packets and total number of received packets divided by the total number of generated packets.

PLR is calculated as:

PDR = (Generated packets - Received Packets)/ Generated packets

4.2 End-to-end delay (EED) –

Data packet experiences end-to-end delay as they travel from source node to destination node. End-to-end delay is calculated using the following formula:

EED= (Time packet received - Time packet sent) / Total number of packets received

4.3 Control Overhead –

It is the ratio of control information received by each node.

5. SIMULATION ENVIRONMENT

Network simulator (NS) is mainly used in simulation of routing and multicast protocols particularly in ad-hoc network researches. And NS IS open source simulator. NS is very useful in simulations for array of popular network protocols which may be wired or wireless. Network Simulator (NS2) version 2 is the second major iteration in network simulation platforms. Mainly NS2 is written in C++ language. But in this C++ objects are also linked to objects in OTcl. In NS2 all the scripts are written in OTcl(Object-oriented Tool Command Language) which is an extension of TCL scripting language.

5.1 Simulation set up -

The simulations were performed using Network Simulator2 (NS2). The traffic sources are CBR (continuous bit – rate). The source-destination pairs are spread randomly over the network. The detailed description of simulation environment is presented below in table1.

Parameter	Value
Simulator	NS-2.34
Radio-propagation model	Propagation/Two ray round wave
Channel type	Channel/Wireless channel
MAC Type	Mac /802.11
Network interface type	Phy/WirelessPhy
Interface queue Type	Queue/Drop Tail
Link Layer Type	LL
Antenna	Antenna/Omni Antenna
Maximum packet in ifq	50
Area (M*M)	1000*1000
Source Type	CBR(constant bit rate)
Simulation Time	150 s
Routing Protocols	DSDV, AODV and DSR
Number of connection	20
Data rate	20 packet/second
Pause time	30 second

Packet size	512 bytes
Mobility Model	Random Way point model
Transmission Range	250 m
Mobility speed	0-20 m/s

Table 1: NS2 Simulation setup

6. RESULTS OF SIMULATION

6.1 Control Overhead -

From the Simulation it is evident that TORA has less control overhead as compared to AODV. This can be verified in the Graph figure 2. It is clear that the overhead of AODV increases with the increase in number of nodes. However, TORA does show a steady overhead with increase in number of nodes.

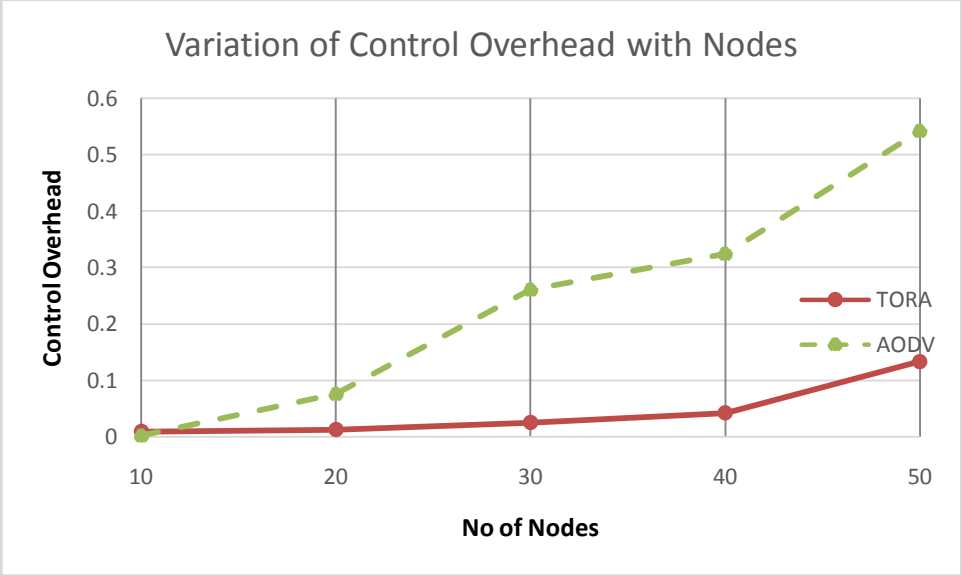

Figure 2. Control Overhead

6.2 End-to-End Delay -

As compared to AODV, TORA shows a steady end-to-end delay, which is higher than AODV. This is as shown in the figure 3.

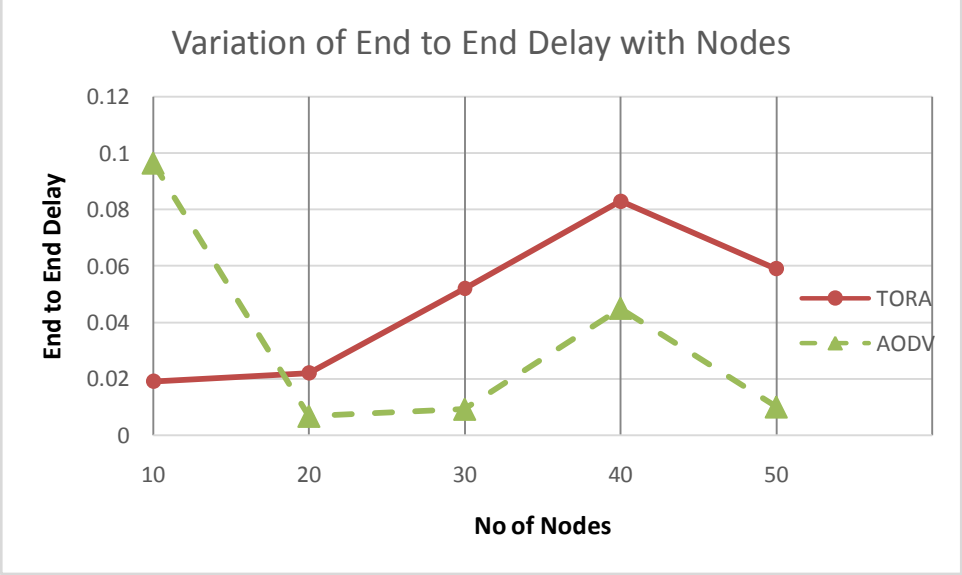

Figure 3. End to End Delay

6.3 Packet Delivery Ratio –

Packet delivery ratio of AODV is far better than TORA and it remains fairly steady throughout. This is evident from the figure 4.

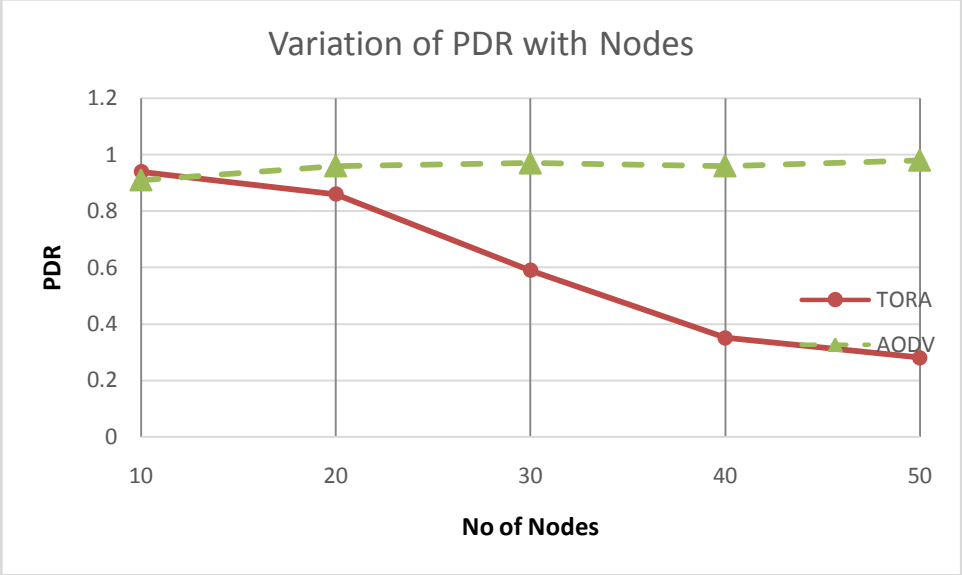

Figure 4. Packet Delivery Ratio

7. CONCLUSION

This paper is attempt to evaluate performance of two commonly used mobile ad hoc routing protocols namely AODV and TORA.Through number simulations in NS-2 performance evaluation is done.AODV and TORA protocols are mainly compared here using Packet Delivery Ratio, End-to-End delay and Routing overhead. We illustrated the simulation results using figures. From simulation result it's clear that TORA has less control overhead as compared to AODV, TORA shows higher end-to-end delay than AODV and Packet delivery ratio of AODV is far better than TORA and it remains fairly steady throughout.

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