Comparative Study on Performance Evaluation of Ad-Hoc Network Routing Protocols

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***Abstract*- Routing of the data packets over the network within reduced time and without much effected by the heavy traffic on network is major concern. Routing protocols are the defined set of rules which help to achieve this aim. An ad hoc network is a collection of mobile nodes forming an instant network without fixed topology. In such a network, each node acts as both router and host simultaneously, and can move out or join in the network freely. A comparative study of reactive and proactive routing algorithms is carried out so that efficient and error free transmission of packets over the network could be easily achieved.**

***Keywords*- Ad-hoc network, Ad-hoc routing, DSDV, WRP, Route Stability**

I. INTRODUCTION

With recent performance advancements in computer and wireless communications technologies, advanced mobile wireless computing is expected to see increasingly widespread use and application, much of which will involve the use of the Internet Protocol (IP) suite. Wired and Wireless networks are validated using simulation or testbeds which is the primarily concern for the performance analysis of each kind of networks. Wireless communication provide Interconnectivity with multiple devices using radio-waves, sometimes light and frees user from many constrains of traditional usage. Ad Hoc network is a connection established for a single session and does not require a router or a wireless base station. It is rapidly deployable, self configuring network which does not incur any need for existing infrastructure and wireless links. Adhoc network is a network without any base stations, infrastructure-less, or multi-hop. Each node has identical capabilities and responsibilities to be performed.

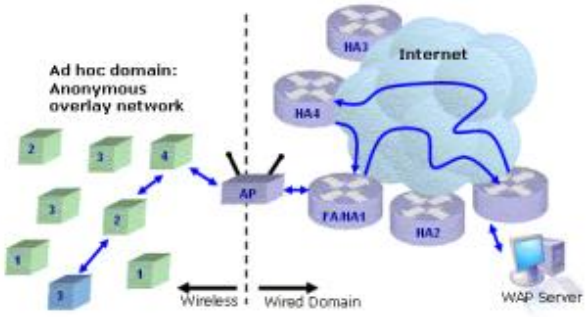

Fig.1 Ad-hoc Network

An ad-hoc network is a self-configuring network of wireless links connecting mobile nodes. Each node in the network may be routers or hosts. The mobile nodes communicate directly with each other without the support of access points. Each node or mobile device is equipped with a transmitter and receiver. These are purpose-specific, autonomous and dynamic. This compares greatly with fixed wireless networks, as there is no master slave relationship that exists in a mobile ad-hoc network. Nodes rely on each other to established communication, thus each node acts as a router. Therefore, in a mobile ad-hoc network, a packet can travel from a source to a destination either directly, or through some set of intermediate packet forwarding nodes.

II. AD-HOC ROUTING

A network is a collection of two or more computing devices connected by a communication medium. When a computing device wishes to send information to another device, it may do so by transmitting the information along a shared communication medium. Routing is a means using which packet is sent from source to destination by following defined path. Router determines the next hop on the network to which a packet should be forwarded toward its final destination. The

router is connected to more than one network and a decision of sending each data packet based on its current state to the other to which it is connected. A router creates or maintains a table of the available routes and their conditions and uses this information along with distance and cost algorithms to determine the best route for a given packet. Routing of packets from one point to other over the network is handled by the protocol of the network layer. During the routing, routing table is maintained and values in table are updated as hop by hop processing towards destination is done.

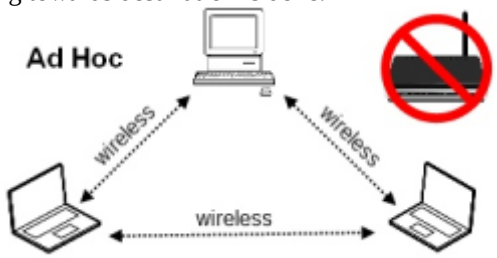

Fig.2 Ad-hoc Routing

A. Characteristics of Ad Hoc Networks

Table 1
Characteristics of Ad Hoc Network

Self Healing	Nodes can join or leave without affecting operation of remaining nodes.
Self organization	Nodes establish a network association without pre configuration.
Peer to Peer	Nodes can communicate without prior arrangement and reliance on centralized resources.
No fixed Infrastructure	Nodes from their own network and become their own network.
Predominance	Adhoc networks are wireless but can be extended to support wired resources.
Dynamic	Topologies are continuously changing and nodes are in motion.
Short range extension	Short range extended by use of multi-hop routing
Central entity	No online central entity

B. Fixed and Wireless Networks

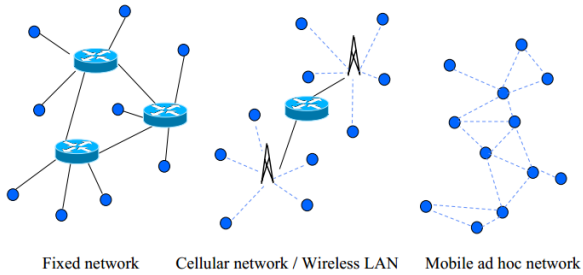

Fig. 3 Wired and Wireless Networks

III. ADHOC ROUTING ALGORITHMS

Routing algorithms are the basic steps used by routers to forward packets between source and destination nodes. Main purpose of routing protocol is to dynamically spread route information of all paths over the network that are used to reach the destination by picking up best suitable shortest path. Routing in Ad Hoc Networks faces many challenges like these networks are based on dynamic topology and has unreliable link and limited resources. In ad hoc networks there is no physical link established and no default router is available for path prediction detection. Ad hoc routing algorithms are categorized into major two categories: uniform and non-uniform routing algorithms.

A. Uniform Routing Algorithm

Link state and distance vector are the two main algorithms which follow uniform routing paradigm.

1) Link State Routing Algorithm

Link state routing protocols are also known as distributed database protocols and work like a road map representing adjoining hop by hop. A link state router has complete information about the network so is not liable to make wrong routing decisions. Link state follow routing by hop by hop understanding approach. Link state router has information of its peers over the network as well as whole information of the other router / nodes over the network. It has complete information of state of each router over the network. Each router originates information about itself, its directly connected links, the state of those links. This information is forwarded from router to router. Each router make a copy of information and update own table without making any changing to the information. The decisive objective is that every router has identical information about the network, and each router will independently calculate its own best paths using some shortest path algorithm. In the Figure 4 {u,v,w,x,y,z} are the nodes or the routers over the network.

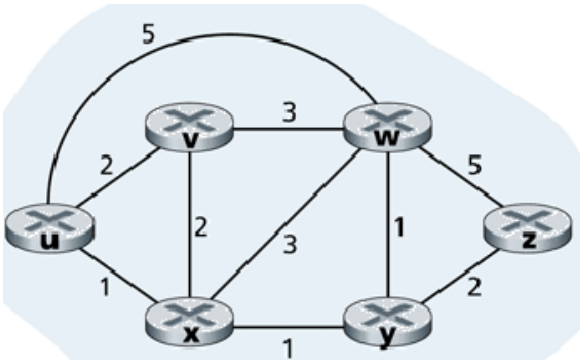

Fig. 4 Link State Routing

2) Distance Vector Routing Algorithm

Distance vector follows routing by rumor routing approach. Distance vector routing protocol is best understood by understanding vector. A vector is a number with two components i.e. magnitude and direction. From the point view of a network, a network has cost and direction or distance and direction. DVRA determines best path on identifying the destination. A router using a distance vector routing protocol does not have the knowledge of the entire path to a destination network. The router has information about the direction of forwarding packets and the distance to the destination network.

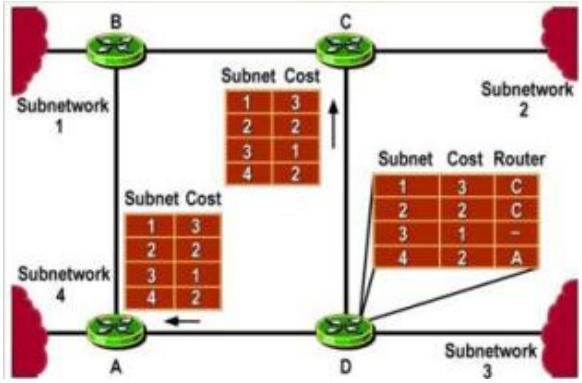

Fig. 5 Distance Vector Routing

Each node *n* maintains a table, which contains a set of distance values $\{d_{nm}(x)\}$, where *m* is a neighbor of *n*. Node *n* consider *k* as next hop for packet needed to be sent to node *x*.

$min\ m\{d(x)\}\ nk = \forall nm$.

B. Proactive Routing Algorithms in Ad-Hoc Network

Proactive routing also known as table driven routing, in this routing tables are created before initiating the routing over the network.

1) Destination Sequenced Distance-Vector

In DSDV, each mobile node of an ad hoc network maintains a routing table, which lists all available destinations, next hop to each destination and a sequence number generated by the destination node. The elements in the routing table of each mobile node change dynamically to keep consistency with dynamically changing topology of an ad hoc network.

2) Performance Evaluation of DSDV

To implement DSDV protocol each node is required to maintain two tables which help in maintaining the complexity. When next hop is encountered the tables are updated and updates are transmitted to neighbors periodically. With the growing number of nodes over the network are with the increase in traffic over the network, size of the bandwidth is also increased and the routing tables are required to update simultaneously. The overhead for maintaining and updating these tables will increase correspondingly. The heavy routing overhead will degrade the performance of the network.

3) Wireless Routing Protocol

WRP is an improvement in distant vector protocol which decreases the convergence time. In WRP each node in a network maintains four tables:

1) *Link Cost Table:* Each node contains information of cost, and identifier for the identification of directed nodes.
2) *Distance Table:* This table keeps information of those nodes that are not directly connected.
3) *Routing Table:* It contains the shortest distance and the up-to-date information of all destinations.
4) *Message Retransmission List (MRL):* Each node over the network sends a message to its neighbors to inform that node is active and waits for the acknowledgement *ack*n from its neighbors. If it does get any *ack*n from any neighbors within a certain time, then MRL list is maintained with this information.

4) Performance Evaluation of WRP

Number of routing protocol packets sent by each protocol obtaining the packet delivery ratio have less routing overhead when the nodes are stationary. Because, when the nodes are not mobile, there is no route breakage and control messages for route construction are not required

C. Reactive Routing Algorithms in Ad-Hoc Network

Reactive protocols set up routes on-demand. These are demand driven protocols. If a node wants to initiate communication with a node to which it has no route, the routing protocol will try to establish a route.

1) Ad-Hoc On-Demand Distance Vector

Topological information is transmitted by nodes on-demand. When a node wants to transmit traffic to a host to which it has no route, it will generate a route request *rreq* message that will be flooded in a limited way to other nodes. Route is considered to be found when the *rreq* reaches either the destination or an intermediate node with a valid route entry for the destination.

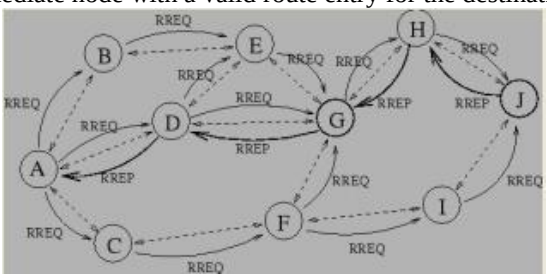

Fig. 6 Routing in AODV

2) Dynamic Source Routing

A route is established on demand using source routing protocol. This protocol requires full information of hops to be established between source and destination nodes to transmit packets and each packet follows the same path. This protocol limits the bandwidth by avoiding the simultaneously table update and long convergence time.

3) Temporally Ordered Routing Algorithm

The Temporally Ordered Routing Algorithm (TORA) is a highly adaptive, efficient and scalable. It is a source-initiated on-demand protocol and it finds multiple routes between the source and the destination. When a link fails the control messages are only propagates around the point of failure. It does not need to re-initiate a route discovery when a link fails.

IV. RESULT

A. *Performance Evaluation of AODV and DSR over High Load Traffic*

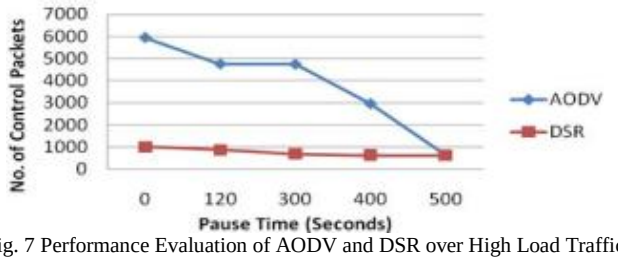

Fig. 7 Performance Evaluation of AODV and DSR over High Load Traffic

Table 2
Performance Evaluation of Proactive and Reactive routing protocols

Parameters	**Proactive Protocols**	**Reactive Protocols**
Route Stability	Compute several sets of routes and index them by time.	Routes may vary with time and can be pre-computed using knowledge about future dynamic topology.
Topological Change	No	Yes
Data Packets Delivered	Does not decrease as these protocols are not concerned with number of nodes over the network.	DSR decreases with the increasing number of nodes. Designed for up to two hundred nodes only.
End-to-End Delay	DSDV delay time increases very sharply with the increasing number of nodes	AODV is consistent with the increasing number of nodes.
Packet Loss	DSDV is has the poor performance and maximum packet loss due to variation in pause time, speed.	Packet loss is minimum.

V. CONCLUSION

DSDV, WRP are considered as representative protocols of proactive routing while AODV and DSR are the representatives of reactive routing protocols. AODV is designed for up to thousands of nodes while DSR is designed up to two hundred nodes. AODV performed better in dense environment except packet loss. AODV and DSR are proved to be better than DSDV. Performance of routing protocols varies with network and selection of accurate routing protocols according to the network, influence the efficiency of network. Proactive protocols outperform in terms of throughput and gets low delay.

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