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Performance Comparison of DSDV, AODV and DSR routing protocols

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ABSTRACT

Mobile Ad Hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any centralized administration, in which individual nodes cooperate by forwarding packets to each other to allow nodes to communicate beyond direct wireless transmission range. Routing is a process of exchanging information from one station to other stations of the network. Routing protocols of mobile ad-hoc network tend to need different approaches from existing Internet protocols because of dynamic topology, mobile host, distributed environment, less bandwidth, less battery power. Ad Hoc routing protocols can be divided into two categories: table-driven (proactive schemes) and on-demand routing (reactive scheme) based on when and how the routes are discovered. In Table-driven routing protocols each node maintains one or more tables containing routing information about nodes in the network whereas in on-demand routing the routes are created as and when required. The table driven routing protocols is Destination Sequenced Distance Vector Routing protocols (DSDV).The on-demand routing protocols are Ad Hoc On-Demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR).

Keywords: MANET, DSDV, AODV, DSR, NS2

I. INTRODUCTION

There are currently two variations of mobile wireless networks infrastructured and Infrastructureless networks.

The ***infrastructured networks,*** also known as Cellular network, have fixed and wired gateways. They have fixed base stations that are connected to other base stations through wires. The transmission range of a base station constitutes a cell. All the mobile nodes lying within this cell connects to and communicates with the nearest bridge (base station). A hand off occurs as mobile host travels out of range of one base station and into the range of another and thus, mobile host is able to continue communication seamlessly throughout the network. Example of this type includes office wireless local area networks (WLANs).

The other type of network, ***Infrastructureless network***, is known as **Mobile Ad NETwork(MANET).** These networks have no fixed routers. All nodes are capable of movement and can be connected dynamically in arbitrary manner. The responsibilities for organizing and controlling the network are distributed among the terminals themselves. The entire network is mobile, and the individual terminals are allowed to move at will relative to each other. In this type of network, some pairs of terminals may not be able to communicate directly to with each other and relaying of some messages is required so that they are delivered to their destinations. The nodes of these networks also function as routers, which discover and maintain routes to other nodes in the networks. The nodes may be located in or on airplanes, ships, trucks, cars, perhaps even on people or very small devices.

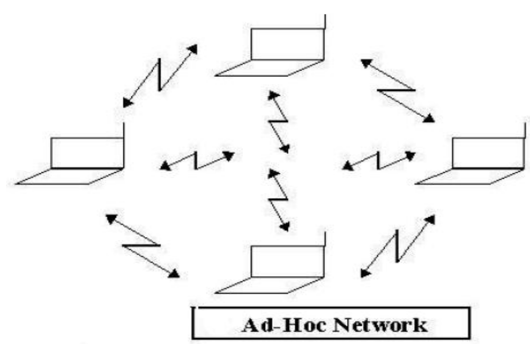

Figure: 1 Ad Hoc Network

A. Characteristics of MANET:

Dynamic Topologies: Since nodes are free to move arbitrarily, the network topology may change randomly and rapidly at unpredictable times. The links may be unidirectional bidirectional.

Bandwidth constrained, variable capacity links: Wireless links have significantly lower capacity than their hardwired counterparts. Also, due to multiple access, fading, noise, and interference conditions etc. the wireless links have low throughput.

Energy constrained operation: Some or all of the nodes in a MANET may rely on batteries. In this scenario, the most important system design criteria for optimization may be energy conservation.

Limited physical security: Mobile wireless networks are generally more prone to physical security threats than are fixed- cable nets. The increased possibility of eavesdropping, spoofing, and denial-of-service attacks should be carefully considered. Existing link security techniques are often applied within wireless networks to reduce security threats. As a benefit, the decentralized nature of network control in MANET provides additional robustness against the single points of failure of more centralized approaches.

II. ROUTING PROTOCOLS

A. Why Routing Protocols are the main issue in Ad Hoc networks?

Routing support for mobile hosts is presently being formulated as mobile IP technology. When the mobile agent moves from its home network to a foreign (visited) network, the mobile agent tells a home agent on the home network to which foreign agent their packets should be forwarded. In addition, the mobile agent registers itself with that foreign agent on the foreign network. Thus, the home agent forwards all packets intended for the mobile agent to the foreign agent, which sends them to the mobile agent on the foreign network. When the mobile agent returns to its original network, it informs both agents (home and foreign) that the original configuration has been restored.

But in Ad Hoc networks there is no concept of home agent as it itself may be moving. Supporting Mobile IP form of host mobility requires address management, protocol inter operability enhancements and the like, but core network functions such as hop by hop routing still presently rely upon pre existing routing protocols operating within the fixed network. In contrast, the goal of mobile ad hoc networking is to extend mobility into the realm of autonomous, mobile, wireless domains, where a set of nodes, which may be combined routers and hosts, themselves form the network routing infrastructure in an ad hoc fashion. Hence, the need to study special routing algorithms to support this dynamic topology environment. Routing protocols for mobile ad-hoc networks have to face the challenge of frequently changing topology, low transmission power and asymmetric links.

B. Ad Hoc Routing Protocols:

A number of routing protocols have been suggested for ad-hoc networks. These protocols can be classified into two main categories:

Table driven routing protocols

Source initiated on demand routing protocols

Table Driven Routing Protocols:

Table-driven routing protocols attempt to maintain consistent, up-to-date routing information from each node to every other node in the network. These protocols require each node to maintain one or more tables to store routing information, and they respond to changes in network topology by propagating updates throughout the network in order to maintain a consistent network view. The areas in which they differ are the number of necessary routing-related tables and the methods by which changes in network structure are broadcast.

Source Initiated on Demand Routing Protocols:

A different approach from table-driven routing is source-initiated on demand routing. This type of routing creates routes only when desired by the source node. When a node requires a route to a destination, it initiates a route discovery process within the network. This process is completed once a route is found or all possible route permutations have been examined. Once a route has been established, it is maintained by a route maintenance procedure until either the destination becomes inaccessible along every path from the source or until the route is no longer desired.

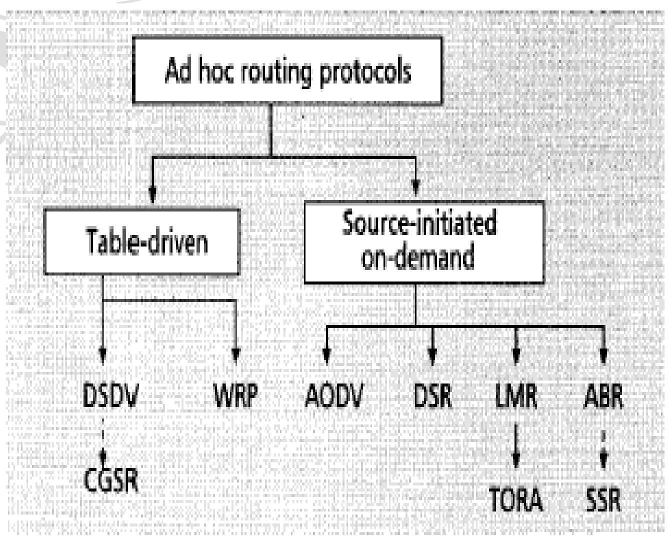

Figure 2: Categorization of ad hoc routing protocols.

III.TABLE DRIVEN ROUTING PROTOCOL

A. Destination Sequenced Distance Vector Routing Algorithm:

Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for adhoc mobile networks based on the Bellman-Ford algorithm. It was developed by C. Perkins and P. Bhagwat in 1994.It eliminates route looping, increases convergence speed, and reduces control message overhead.

In DSDV, each node maintains a next-hop table, which it exchanges with its neighbours. There are two types of next-hop table exchanges: periodic full-table broadcast and event-driven incremental updating. The relative frequency of the full-table broadcast and the incremental updating is determined by the node mobility. In each data packet sent during a next-hop table broadcast or incremental updating, the source node appends a sequence number. This sequence number is propagated by all nodes receiving the corresponding distance-vector updates, and is stored in the next-hop table entry of these nodes. A node, after receiving a new next-hop table from its neighbour, updates its route to a destination only if the new sequence number is larger than the recorded one, or if the new sequence number is the same as the recorded one, but the new route is shorter. In order to further reduce the control message overhead, a settling time is estimated for each route. A node updates to its neighbours with a new route only if the settling time of the route has expired and the route remains optimal.

IV. SOURCE INITIATED ON DEMAND ROUTING

A. Ad Hoc on Demand Distance Vector Routing (AODV):

The Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner. The operation of AODV is loop-free, and by avoiding the Bellman-Ford "counting to infinity" problem offers quick convergence when the adhoc network topology changes (typically, when a node moves in the network). When links break, AODV causes the affected set of nodes to be notified so that they are able to invalidate the routes using the lost link. Route Requests (RREQs), Route Replies (RREPs) and Route Errors (RERRs) are message types defined by AODV.

B. Dynamic Source Routing Protocol (DSR):

The Dynamic Source Routing protocol (DSR) is an on demand routing protocol. DSR is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. Using DSR, the network is completely self organizing and self-configuring, requiring no existing network infrastructure or administration. The DSR protocol is composed of two main mechanisms that work together to allow the discovery and maintenance of source routes in the ad hoc network:

- Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D. Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D.
- Route Maintenance is the mechanism by which node S is able to detect, while using a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. When Route Maintenance indicates a source route is broken, S can attempt to use any other route it happens to know to D, or it can invoke Route Discovery again to find a new route for subsequent packets to D. Route Maintenance for this route is used only when S is actually sending packets to D.

In DSR Route Discovery and Route Maintenance each operates entirely on demand.

V. METHODOLOGY

In this section we have described about the tools and methodology used in our paper for analysis of adhoc routing protocol performance i.e. about simulation tool, simulation model, simulation environment performance metrics used.

A. Simulation Tool:

In this paper the simulation tool used for analysis is NS-2 which is highly preferred by research communities. NS is a discrete event simulator targeted at networking research. Ns provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks. NS2 is an object oriented simulator, written in C++, with an OTcl interpreter as a frontend. This means that most of the simulation scripts are created in Tcl(Tool Command Language). If the components have to be developed for ns2, then both tcl and C++ have to be used.

B. Why we chosen NS-2?

NS-2 is chosen as the simulation tool among the others simulation tools because NS-2 supports networking research and education. Ns-2 is suitable for designing new protocols, comparing different protocols and traffic evaluations. NS-2 is developed as a collaborative environment. It is distributed freely and open source. A large amount of institutes and people in development and research use, maintain and develop NS-2. This increase the confidence in it. Versions are available for FreeBDS, Linux, Solaris, Windows, Mac OS X. NS-2 also provides substantial support for simulation of TCP, UDP, routing and multicast protocols over wired and wireless networks.

C. Simulation Model:

We run the simulation in Network Simulator (NS-2) accepts as input a scenario file that describes the exact motion of each node and the exact packets originated by each node, together with the exact time at which each change in motion or packet origination is to occur. The detailed trace file created by each run is stored to disk, and analyzed using a variety of scripts, particularly one called file *.tr that counts the number of packets successfully delivered and the length of the paths taken by the packets, as well as additional information about the internal functioning of each scripts executed. This data is further analyzed with AWK file and Microsoft Excel to produce the graphs.

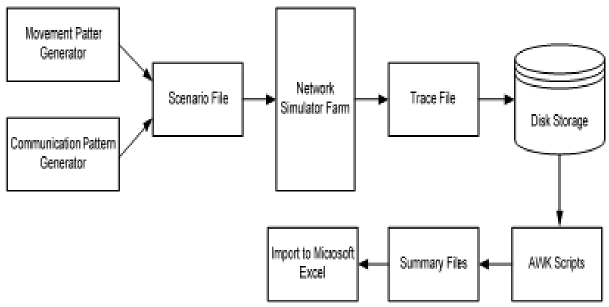

Figure 3: Overview of simulation model

D. Simulation Environment:

The performance analysis is done on Linux Operating System. Ns –allinone-2.34 was installed.

Platform	Linux Operating System
NS version	Ns –allinone-2.34
Simulation time	200 s
Number of nodes	50 wireless nodes
Traffic	CBR(Constant Bit Rate)
CBR Packet size	512 bytes
Simulation Area size	500 x 500 m
Mobility model	Random WayPoint mobility

Table1: Simulation Environment

E. Performance Metrics:

The project focuses on 4 performance metrics which are quantitatively measured. The performance metrics are important to measure the performance and activities that are running in NS-2 simulation. The performance metrics are:

Packet Delivery ratio: Ratio between no. of packet sent and the no of packet received.

End to end delay: Time interval between sending of packets from the source node and the receiving of packet by destination node.

Throughput: Total number of successful received packet at destination during simulation time.

Path optimality: The difference between the path actually taken and the best possible path for a packet to reach its destination.

VI. CONCLUSION

Here we described routing protocols for ad hoc wireless networks. We also provide the classification of these schemes according to Routing strategy. i.e. Table driven and on demand. Each protocol performs differently under different circumstances. So, network context and goal must be kept in mind before choosing any routing protocol.

As this is our proposed approach, we will compare the DSDV, AODV and DSR on the matrices such as packet delivery ratio, end to end delay, throughput and path optimality and trying to show which protocol is giving the optimized performance than the other.

The field of Adhoc network mobile network is rapidly growing and changing. While there are still many challenges that need to met, it is likely that such network will see widespread use within the coming days.

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