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A Survey on Optimal Route Selection and Load Balancing in MANET

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ABSTRACT

MANET is a self-organized and self-configurable network where the mobile nodes move arbitrarily. Routing is a critical issue in MANET and hence the focus of this paper along with the performance analysis of routing protocols and growing interest in mobile ad hoc network technique has resulted in many routing protocol proposal. The objective of this paper is to create taxonomy of the mobile ad hoc routing protocols, and to survey and compare representative examples for each class of protocols. We compared three types of routing protocols i.e. proactive, reactive and hybrid. The performance of all these routing protocols is analysed by Q0S parameters. All the MANET routing protocols are explained in a deep way with QoS metrics.
Keywords : MANET, Q0S, Routing, Routing protocols, Time Complexity.

I. INTRODUCTION

A MANET is a self-sorting out and self-arranging multichip remote system, where the system structure changes rapidly because of part portability. Impromptu remote system are self-making and self-sorting out and self-administrating. The nodes are allowed to move haphazardly and arrange themselves self-assertively; in this way, the system's remote topology may change quickly and eccentrically. Such a system may work in a standalone style, or may be associated with the bigger Internet [1]. Versatile nodes that are within each other's radio reach impart straightforwardly through remote connections, while those far separated depend on different nodes to hand-off messages as switches. In specially appointed system, every hub demonstrations as both a host and a switch, which advances the information, proposed for some other hub.

A specially appointed system may comprise of a few home-figuring gadgets, including portable workstations, PDAs, et cetera. Every hub will have the capacity to speak straightforwardly with whatever other hub that lives inside of its transmission range [2]. For corresponding with nodes that live past this range, the hub needs to utilize transitional nodes to transfer the messages bounce by jump.

Directing methodologies in Mobile Ad Hoc Network

- In MANET, courses are chiefly multi bounce in view of the constrained radio proliferation reach and topology changes much of the time and eccentrically since every system host moves arbitrarily. In this way, directing is a necessary piece of specially appointed interchanges.
- Routing is to discover and keep up courses between nodes in a dynamic topology with potentially uni-directional connections, utilizing least ass

II. METHODS AND MATERIAL

A. Routing Protocols in MANET

1. Table-determined or Proactive Protocols:

Proactive directing conventions endeavor to look after reliable, up and coming steering data between every pair of nodes in the system by proliferating, proactively, course upgrades at settled interims. Agent proactive conventions include: Destination-Sequenced Distance-Vector (DSDV) directing, Clustered Gateway Switch Routing (CGSR), Wireless Routing

Protocol (WRP), Optimized Link State Routing (OLSR)and The Fisheye State Routing (FSR).

2. On-interest or Reactive Protocols:

An alternate methodology from table-driven directing is receptive or on-interest steering. Responsive conventions, dissimilar to table-driven ones, set up a course to a destination when there is an interest for it, typically started by the source hub through disclosure transform inside of the system. Responsive conventions, not at all like table-driven ones, set up a course to a destination when there is an interest for it, typically started by the source hub through disclosure transform inside of the system. Agent receptive steering conventions include: Dynamic Source Routing (DSR), Ad hoc On Demand Distance Vector (AODV) directing, Temporally Ordered Routing Algorithm (TORA) and Associativity Based Routing (ABR).

3. Hybrid Routing Protocols:

Purely proactive or responsive conventions perform well in a restricted district of system setting. Then again, the different utilizations of specially appointed systems over an extensive variety of operational conditions and system design represent a test for a solitary convention to work productively. Scientist's backer that the issues of effective operation more than an extensive variety of conditions can be tended to best match these operational conditions [5]. Delegate half-and-half steering conventions include: Zone Routing Protocol (ZRP) and Zone-based Hierarchal Link state directing convention (ZHLS).

B. Destination-Sequenced Distance-Vector (DSDV) steering

Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven steering plan for specially appointed portable systems in view of the Bellman-Ford calculation. The principle commitment of the calculation was to tackle the Routing Loop issue. DSDV meets expectations in the accompanying way. Every steering table passage conveys bounce separation and next jump for every single accessible destination (as in B-F). What's more, every section is labeled with a grouping number which begins from the destination station. The steering data is publicized by TV occasionally and incrementally. After accepting the steering data, courses with later grouping numbers are favored as the premise for settling on sending choices of the ways with the same arrangement number; those with the briefest bounce separation will be utilized. That data (i.e. next bounce and jump separation) is entered in the steering table, alongside the related succession number tag. At the point when the connection to the following bounce has fizzled, any course through that next jump is promptly doled out a 1 interminable jump separation and its arrangement number is upgraded. At the point when a hub gets a telecast with a boundless 1 metric, and it has a later arrangement number to that destination, it triggers a course overhaul show to spread the essential news about that destination.

The point of preference is it is truly suitable for making specially appointed systems with little number of nodes. The DSDV convention is demonstrated to ensure circle free ways to every destination at all moments. DSDV obliges a consistent overhaul of its directing tables, which uses up battery force and a little measure of transmission capacity notwithstanding when the system is unmoving. DSDV is not suitable for very dynamic systems. There is no business usage of this calculation.

C. Cluster-head Gateway Switch Routing (CGSR)

Bunch head Gateway Switch Routing (CGSR) Protocol is a progressive convention based upon the DSDV Routing calculation utilizing a bunch head to deal with a gathering of activity nodes. The calculation meets expectations in an exceptionally straightforward way. At that point which thusly transmits it to the door of the destination group. The destination group head transmits it to the destination hub. There are various streamlined group head race systems. On getting a bundle, a hub finds the closest bunch head along the course to the destination as indicated by the group part table and the steering table. At that point the hub counsels its directing table to locate the following bounce keeping in mind the end goal to achieve the bunch head chose in step one and transmits the parcel to that hub. The hub counsels its steering table to locate the following jump keeping in mind the end goal to achieve the bunch head chose in step one and transmits the parcel to that hub.

D. Wireless Routing Protocol (WRP)

The Wireless Routing Protocol (WRP) [7] is a proactive unicast steering convention for versatile specially appointed systems. WRP uses enhanced Bellman-Ford Distance Vector steering calculation. Utilizing WRP, every versatile hub keeps up a separation table, a directing table, a connection expense table and a Message Retransmission List (MRL). A passage in the directing table contains the separation to a destination hub, the antecedent and the successor along the ways to the destination, and a tag to distinguish its state, i.e., is it a straightforward way, a circle or invalid. Putting away ancestor and successor in the directing table serves to distinguish steering circles and abstain from checking to interminability issue, which is the primary weakness of the first separation vector steering calculation. A versatile hub makes a passage for every neighbor in its connection expense table. In WRP, versatile nodes trade directing tables with their neighbors utilizing redesign messages.

The redesign messages can be sent either occasionally or at whatever point connection state changes happen. The MRL contains data about which neighbor has not recognized a redesign message. Furthermore, if there is no adjustment in its steering table since last redesign, a hub is obliged to send a Hello message to guarantee network. On getting a redesign message, the hub alters its separation table and searches for better directing ways as per the upgraded data. In WRP, a hub checks the consistency of its neighbors in the wake of distinguishing any connection change.

WRP has the same point of interest as that of DSDV. What's more, it has speedier joining and includes less table upgrades. Calculation is straightforward in usefulness. The many-sided quality of support of various tables requests a bigger memory and all through the whole system, this builds the conventions data transfer capacity utilization.

E. Optimized Link State Routing (OLSR) Protocol

The convention is an advancement of the established connection state calculation custom-made to the prerequisites of a versatile remote LAN. The key idea utilized as a part of the convention is that of multipoint transfers (MPRs). MPRs are chosen nodes which forward telecast messages amid the flooding procedure. This system considerably decreases the message overhead when contrasted with a traditional flooding component, where each hub retransmits every message when it gets the first duplicate of the message. In OLSR, connection state data is produced just by nodes chose as MPRs. Along these lines, a second enhancement is accomplished by minimizing the quantity of control messages overwhelmed in the system. As a third streamlining, a MPR hub may decide to report just connections in the middle of it and its MPR selectors. Consequently, as opposed to the excellent connection state calculation, fractional connection state data is dispersed in the system. This data is then utilized for course estimation. OLSR gives ideal courses (as far as number of jumps). The convention is especially suitable for vast and thick systems as the strategy of MPRs functions admirably in this connection.

Advantages of OLSR is it is a flat routing protocol, it does not need central administrative system to handle its routing process Due to the OLSR routing protocol simplicity in using interfaces, it is easy to integrate the routing protocol in the existing operating systems, without changing the format of the header of the IP messages. The one great advantage of the OLSR protocol is that it immediately knows the status of the link and it is possibly to extend the quality of service(QoS) information to such protocol so that the hosts know in advantage the quality of the route. The proposed protocol is best suitable for large and dense ad hoc networks. OLSR protocol needs that each host periodic sends the updated topology information greater processing power from nodes in the ad hoc wireless network.

F. The Fisheye State Routing (FSR)

The Fisheye State Routing (FSR) is a proactive unicast routing protocol based on Link State routing algorithm with effectively reduced overhead to maintain network topology information. As indicated in its name, FSR utilizes a function similar to a fish eye. The eyes of fishes catch the pixels near the focal with high detail, and the detail decreases as the distance from the focal point increases.

Similar to fish eyes, FSR maintains the accurate distance and path quality information about the immediate neighboring nodes, and progressively reduces detail as the distance increases. In Link State routing algorithm used for wired networks, link state updates are generated and flooded through the network whenever a node detects a topology change. In FSR, however, nodes exchange link state information only with the neighboring nodes to maintain up-to-date topology information. Link state updates are exchanged periodically in FSR, and each node keeps a full topology map of the network. To reduce the size of link state update messages, the key improvement in FSR is to use different update periods for different entries in the routing table. Link state updates corresponding to the nodes within a smaller scope are propagated with higher frequency.

G. On-demand or Reactive Protocols:

- ✓ **Dynamic Source Routing (DSR)**

Dynamic Source Routing (DSR) is a routing protocol for wireless mesh networks. It is similar to AODV in that it forms a route on-demand when a transmitting computer requests one. There are 2 major phases:-Route discovery – uses route request and route reply packets. Route maintenance–uses route error packets and acknowledgments.

The protocol allows multiple routes to any destination and allows each sender to select and control the routes used in routing its packets, for example for use in load balancing or for increased robustness. Other advantages of the DSR protocol include easily guaranteed loop-free routing, support for use in networks containing unidirectional links, use of only "soft state" in routing, and very two hundred nodes, and is designed to work well with even very high rates of mobility.

- ✓ **Ad hoc On Demand Distance Vector (AODV) routing**

The AODV is a reactive [3, 4] protocol derived from Dynamic Source Routing and DSDV and DSR it combines the advantages of both protocols. Its route discovery procedure is similar to DSR. When a node has a packet to send to a particular destination, if it does not know a valid route, it broadcasts a route request packet, by specifying the destination address.

The neighbors without a valid route to the destination establish a reverse route and rebroadcast route request packet. The route maintenance is done by exchanging beacon packets at regular intervals. This protocol adapts to highly dynamic topology and provide single route for communication.

- ✓ **Temporally Ordered Routing Algorithm (TORA)**

Temporally Ordered Routing Algorithm (TORA) is a uniform, destination-based, reactive protocol. A destination- oriented directed acyclic graph is built for each destination. If connectivity changes result in a node losing its entire outbound links, the node “reverses" the direction of some or its entire inbound links. TORA assumes that each node is informed of link-status changes for any of its immediate neighbors. When a source has no route to a destination, it broadcasts a route request for the destination. The request is rebroadcast until it reaches the destination, which is de need to have zero height with respect to itself. The destination broadcasts an update message, indicating its height. Each node that receives the update message updates its height to be one higher than the height in the update message and broadcasts an update message, indicating its new height. The updates must be broadcast reliably and ordered by a synchronized clock or logical timestamp in order to prevent long-lived loops. This process creates a DAG from the source to the destination, which is used for hop-by-hop routing. A route failure is propagated only when a node loses its last downstream link. TORA distinguishes nodes whose height already reflects a link reversal (“reflected"). Again reliable, ordered broadcast is required in order to prevent long- lived routing loops. The destination is the only node with no outgoing link. The maintenance of DAG provides loop free communication to the destination.

H. Quality of Service (QoS)

QoS is usually defined as a set of service requirements that needs to be met by the network while transporting a packet stream from a source to its destination. The network is expected to guarantee a set of measurable pre-specified service attributes to the users in terms of end-to-end performance, such as time, bandwidth requirement, probability of packet loss, the variation in latency (jitter), Route acquisition Delay, Communication Overhead, Scalability etc. Quality of services for a network is measured in terms of guaranteed amount of data which a network transfers from one place to another in a given time slot. The size of the ad-hoc network is directly related to the quality of service (QoS) of the network. If the size of the mobile ad-hoc network is large, it might make the problem of network control extremely difficult. Quality of service (QoS) is the performance level of a service offered by the network to the user [8]. The goal of QoS provisioning is to achieve a more deterministic network behavior, so that information carried by the network can be better delivered and network resources can be better utilized.

I. QoS Parameters in Mobile Ad Hoc Networks

As different applications have different requirements, the services required by them and the associated QoS parameters differ from application to application. For example, in case of multimedia applications time, bandwidth requirement, power requirement, probability of packet loss, the variation in latency (jitter), Route acquisition Delay, Communication Overhead, Scalability are the key QoS parameters, whereas military applications have stringent security requirements. For applications such as emergency search and rescue operations, availability of network is the key QoS parameter. In WNs the QoS requirements are more influenced by the resource constraints of the nodes. Some of the resource constraints are battery charge, processing power, and buffer space.

Time complexity is defined as the largest time that can elapse between the moment T when the last topology change occurs and the moment at which all the routers have final shortest path and distance to all other routers.Delay is the time elapsed from the departure of a data packet from the source node to the arrival at the destination node, including queuing delay, switching delay, propagation delay, etc.

Jitter is generally referred to as variations in delay, despite many other definitions. It is often caused by the difference in queuing delays experienced by consecutive packets.

Scalability: It is the ability of a computer application or product (hardware or software) to continue to function well when it (or its context) is changed in size or volume in order to meet a user need.

Packet loss rate is the percentage of data packets that are lost during the process of transmission.

III. RESULTS AND DISCUSSION

Comparison of routing protocols in mobile ad hoc networks

Now we will show the comparison between Table Driven, Demand Driven and Hybrid protocol. Table 1 the protocols and comparison between their QoS parameters, Demand Driven (On-Demand) with four types of protocols such as TORA, DSR, AODV and ABR and comparison between them shows in table 2.Table. Table 3 shows the Table Driven for four kind of protocols such as WRP, CGSR, DSDV, OLSR and comparison between them, 4 shows Time complexity of MANET Routing protocol and then Table-4: Time complexity of MANET Routing protocol Table 1: Shows the Table-Driven four kinds of protocols and comparison between them. Table 2: Shows the Demand Driven (On-Demand) with four types of protocols and comparison between them. Table 3: Shows the protocols and comparison between their QoS parameter.

Parameter	Table Driven (Proactive)	Demand Zriven (Reactive)	Hybrid
Routing Structure	Flat and hierarchical structure	Mostly Flat	Hierarchical
Bandwidth requirement	High	Low	Medium
Power requirement	High	Low	Medium
Route acquisition delay	Lower	Higher	Lower for Intra-zone; Higher for Inter-zone
Control Overhead	High	Low	Medium
Communication Overhead	High	Low	Medium

Scalability	Up to hundred nodes	Up to few hundred nodes	Designed for up to 1000 or more nodes
Topology dissemination	Periodical	On-Demand	Both

On-Demand	TORA	DSR	AODV	ABR
Routing Structure	Flat	Flat	Flat	Flat
Overall complexity	High	Medium	Medium	High
Frequency of update transmissions	Event driven	Event driven	Event driven	Periodically
Updates transmitted to	Neighbors	Source	Source	Source
Overhead	Medium	Medium	Low	High
Loop Free	Yes	Yes	Yes	Yes
Utilize hello messages	No	No	Yes	Yes
Multiple route support	Yes	Yes	No	No
Routing metric	Shortest path	Shortest path	Freshest & Shortest path	Associatively & shortest path & others

Protocol	Type	Time Complexity
DSDV	Table Driven	O (d)
CGSR	Table Driven	O (d)
WRP	Table Driven	O (d)
OLSR	Table Driven	O (d)
DSR	Demand Driven	O (2d)
AODV	Demand Driven	O (2d)
TORA	Demand Driven	O (2d)
ABR	Demand Driven	O(d+z)
ZRP	Hybrid	O (2d)

Table Driven	CGSR	WRP	DSDV	OLSR
Routing Structure	Hierarchical	Flat	Flat	Flat
Overall complexity	High	Low	High	Low
Frequency of update transmissions	Periodically	Periodically and as needed	Periodically and as needed	Periodically
Updates transmitted to	Neighbors and cluster Head	Neighbors	Neighbors	Neighbors
Scalable	No	Yes	Yes	Yes
Loop Free	Yes	Yes but non instantaneously	Yes	Yes
Utilize hello messages	NO	YES	YES	YES
Critical nodes	Cluster head	NO	NO	MPRs
Multiple route support	NO	NO	NO	NO
Routing metric	Shortest path	Shortest path	Shortest path	Shortest path

Table-4 : Time complexity of MANET Routing protocol

IV. CONCLUSION

MANETS are relied upon to assume a vital part in the organization of future remote correspondence frameworks. Steering is a fundamental segment of correspondence conventions in versatile specially appointed systems. The outline of the conventions are driven by particular objectives and prerequisites in view of individual presumptions about the system properties or application zone. Thusly, it is critical that these systems ought to have the capacity to give productive nature of administration (QoS) that can meet the seller prerequisites. To give proficient nature of administration in versatile specially appointed systems, there is a strong need to build up new architectures and administrations for routine system controls. The time deferral is the primary sympathy toward QoS of directing conventions requesting that constant information be transmitted inside of a positive time interim. QoS backing is key for supporting time basic movement sessions. In this section we have examination of proactive and receptive and cross breed steering conventions in light of huge QoS parameter like throughput, data transfer capacity, time many-sided quality, Power prerequisite, Route obtaining postponement, Control overhead, Routing Structure, Communication Overhead, Scalability and so on. The study tries to survey average directing conventions and uncover the qualities and exchange offs.

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