Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI: 10.21474/IJAR01/2512
DOI URL: http://dx.doi.org/10.21474/IJAR01/2512
ISSN NO. 2320-5407

RESEARCH ARTICLE

EVALUATION OF ROUTING PROTOCOLS IN MANETS.

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Manuscript Info

Manuscript History

Received: 25 October 2016
Final Accepted: 23 November 2016
Published: December 2016

Abstract

MANETs employ the traditional TCP/IP structure to provide end-to-end communication between nodes. However, due to their mobility and the limited resource in wireless networks, each layer in the TCP/IP model require redefinition or modifications to function efficiently in MANETs. One interesting research area in MANET is routing. Routing in the MANETs is a challenging task and has received a tremendous amount of attention from researches. This has led to development of many different routing protocols for MANETs A Mobile Ad-Hoc Network (MANET) is a self-configuring network and the nodes are connected through wireless link. It is an infrastructure less network. The wireless network topology may change rapidly. Each node in the network act as router and it communicate other nodes. There is no centralized administration. Nodes in ad hoc networks are differentiated by their limited resources like power, memory and mobility. If a node needs to communicate with another that is outside its transmission range, an intermediate node acts as a router to relay or forward packets from the source to the destination. For this purpose, a routing protocol is needed. This paper presents a survey on various routing protocols.

Introduction:-

A collection of mobile nodes are comprised into the Mobile Ad-hoc Networks (MANETs). The mobile nodes creates a wireless networks among themselves without using any infrastructure or administrative support dynamically. Ad-hoc wireless networks are self-creating, self-organizing, and self-administering. By communicating among their component mobile nodes they inherit from being exclusive. Therefore, in order to provide the necessary control and administration function, such communications are used for supporting such networks . In earlier days due to such apparent advantages, military, police, and rescue agencies particularly under disorganized or hostile environments, as well as isolated scenes of natural disaster and armed conflict, utilize Ad-hoc networks. The potential applications which are used in other major areas are home, small office networking, in a small area, collaborative computing with laptop computers. Moreover, in all the conventional areas of interest for mobile computing, Ad-hoc networking has clear potential applications .

Characteristics of Manets:-

- In MANET, each node act as both host and router. That is it is autonomous in behavior.
- Multi-hop radio relaying- When a source node and destination node for a message is out of the radio range, the MANETs are capable of multi-hop.

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- Distributed nature of operation for security, routing and host configuration. A centralized firewall is absent here.
- The nodes can join or leave the network anytime, making the network topology dynamic in nature.
- Mobile nodes are characterized with less memory, power and light weight features.
- The reliability, efficiency, stability and capacity of wireless links are often inferior when compared with wired links. This shows the fluctuating link bandwidth of wireless links.
- Mobile and spontaneous behavior which demands minimum human intervention to configure the network.
- All nodes have identical features with similar responsibilities and capabilities and hence it forms a completely symmetric environment.
- High user density and large level of user mobility.
- Nodal connectivity is intermittent.

Manets challenges:-

A Manet environment has to overcome certain issues of limitation and inefficiency. It includes:The wireless link characteristics are time-varying in nature: There are transmission impediments like fading, path loss, blockage and interference that adds to the susceptible behavior of wireless channels. The reliability of wireless transmission is resisted by different factors.

- Limited range of wireless transmission – The limited radio band results in reduced data rates compared to the wireless networks. Hence optimal usage of bandwidth is necessary by keeping low overhead as possible.
- Packet losses due to errors in transmission – MANETs experience higher packet loss due to factors such as hidden terminals that results in collisions, wireless channel issues (high bit error rate (BER)), interference, frequent breakage in paths caused by mobility of nodes, increased collisions due to the presence of hidden terminals and uni-directional links.
- Route changes due to mobility- The dynamic nature of network topology results in frequent path breaks.
- Frequent network partitions- The random movement of nodes often leads to partition of the network. This mostly affects the intermediate nodes.

Routing protocol in manet:-

"Routing is the process of information exchange from one host to the other host in a network.". Routing is the mechanism of forwarding packet towards its destination using most efficient path. Efficiency of the path is measured in various metrics like, Number of hops, traffic, security, etc. In Ad-hoc network each host node acts as specialized router itself . Routing protocol in MANET is classified into three categories on the basis of route discovery

Proactive also known as table driven protocol and

Reactive also called as on demand routing protocol.

Table Driven Routing Protocols:-

In Table-driven routing protocols each node maintains one or more tables containing routing information to every other node in the network. All nodes update these tables so as to maintain a consistent and up-to-date view of the network. When the network topology changes the nodes propagate update messages throughout the network in order to maintain a consistent and up-to-date routing information about the whole network. These routing protocols differ in the method by which the topology change information is distributed across the network and the number of necessary routing-related tables. The following sections discuss some of the existing table-driven ad hoc routing protocols.

Dynamic Destination-Sequenced Distance-Vector Routing Protocol:-

The Destination-Sequenced Distance-Vector (DSDV) Routing Algorithm is based on the idea of the classical Bellman-Ford Routing Algorithm with certain improvements.Every mobile station maintains a routing table that lists all available destinations, the number of hops to reach the destination and the sequence number assigned by the destination node. The sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. The stations periodically transmit their routing tables to their immediate neighbors. A station also transmits its routing table if a significant change has occurred in its table from the last update sent. So, the update is both time-driven and event-driven. The routing table updates can be sent in two ways:- a "full dump" or an incremental update. A full dump sends the full routing table to the neighbors and could span many packets whereas in an incremental update only those entries from the routing table are sent that has a metric change since the last update and it must fit in a packet. If there is space in the incremental update packet then those entries may be

included whose sequence number has changed. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. In a fast-changing network, incremental packets can grow big so full dumps will be more frequent. Each route update packet, in addition to the routing table information, also contains a unique sequence number assigned by the transmitter. The route labeled with the highest (i.e. most recent) sequence number is used. If two routes have the same sequence number then the route with the best metric (i.e. shortest route) is used. Based on the past history, the stations estimate the settling time of routes. The stations delay the transmission of a routing update by settling time so as to eliminate those updates that would occur if a better route were found very soon.

Wireless Routing Protocol:-

WRP [15] belongs to the general class of path-finding algorithms defined as the set of distributed shortest path algorithms that calculate the paths using information regarding the length and second-to-last hop of the shortest path to each destination. WRP reduces the number of cases in which a temporary routing loop can occur. WRP uses periodic update message transmissions to the neighbors of a node. The nodes in the response list of update message (which is formed using MRL) should send acknowledgments. If there is no change from the last update, the nodes in the response list should send an idle Hello message to ensure connectivity. A node can decide whether to update its routing table after receiving an update message from a neighbor and always it looks for a better path using the new information. If a node gets a better path, it relays back that information to the original nodes so that they can update their tables. After receiving the acknowledgment, the original node updates its MRL. Thus, each time the consistency of the routing information is checked by each node in this protocol, which helps to eliminate routing loops and always tries to find out the best solution for routing in the network [8].

Global State Routing:-

Global State Routing (GSR) is similar to DSDV described in section 2.1. It takes the idea of link state routing but improves it by avoiding flooding of routing messages.In this algorithm, each node maintains a Neighbor list, a Topology table, a Next Hop table and a Distance table. Neighbor list of a node contains the list of its neighbors (here all nodes that can be heard by a node are assumed to be its neighbors.). For each destination node, the Topology table contains the link state information as reported by the destination and the timestamp of the information. For each destination, the Next Hop table contains the next hop to which the packets for this destination must be forwarded. The Distance table contains the shortest distance to each destination node.The routing messages are generated on a link change as in link state protocols. On receiving a routing message, the node updates its Topology table if the sequence number of the message is newer than the sequence number stored in the table. After this the node reconstructs its routing table and broadcasts the information to its neighbors.

On Demand Routing Protocols:-

Reactive routing is also known as on-demand routing protocol since they do not maintain routing information or routing activity at the network nodes if there is no communication. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet. The route discovery occurs by flooding the route request packets throughout the network.

Ad hoc On-demand Distance Vector Routing:-

Ad hoc On-demand Distance Vector Routing (AODV) is an improvement on the DSDV algorithm. AODV minimizes the number of broadcasts by creating routes on-demand as opposed to DSDV that maintains the list of all the routes.To find a path to the destination, the source broadcasts a route request packet. The neighbors in turn broadcast the packet to their neighbors till it reaches an intermediate node that has a recent route information about the destination or till it reaches the destination . A node discards a route request packet that it has already seen. The route request packet uses sequence numbers to ensure that the routes are loop free and to make sure that if the intermediate nodes reply to route requests, they reply with the latest information only.When a node forwards a route request packet to its neighbors, it also records in its tables the node from which the first copy of the request came. This information is used to construct the reverse path for the route reply packet. AODV uses only symmetric links because the route reply packet follows the reverse path of route request packet. As the route reply packet traverses back to the source, the nodes along the path enter the forward route into their tables.If the source moves then it can reinitiate route discovery to the destination. If one of the intermediate nodes move then the moved nodes neighbor realizes the link failure and sends a link failure notification to its upstream neighbors and so on till it reaches the source upon which the source can reinitiate route discovery if needed.

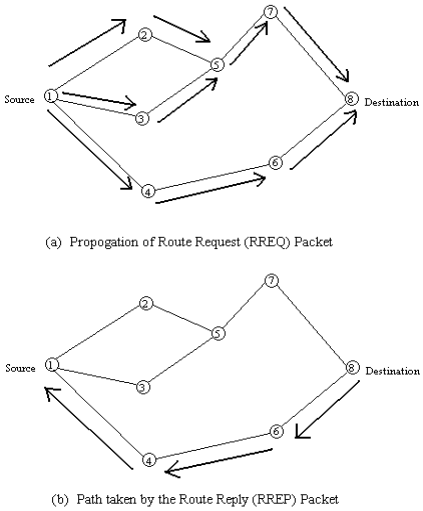

Figure 1:- Route discovery in AODV

Dynamic Source Routing:-

Dynamic Source Routing is a reactive protocol that is based on two main mechanisms: route discovery and route maintenance. Both mechanisms are implemented in an ad hoc fashion and in the absence of any kind of periodic control messages. The main concept of the protocol is"source routing", in which nodes place in the header of a packet the route that the packet must follow from a source to a destination. Each node "caches" the routes to any destination that has recently used, or discovered by overhearing its neighbors" transmission. When there is no such route, a route discovery process is initiated. The protocol is designed for a MANET of up to two hundreds nodes with high mobility rates and is loop-free.

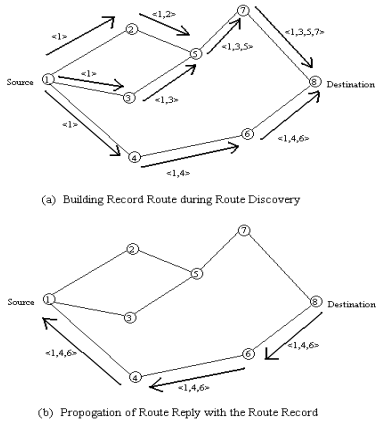

Fig 2:- Creation Of record in DSRP

Associativity-Based Routing (ABR):-

ABR protocol defines a new type of routing metric"degree of association stability" for mobile ad hoc networks. In this routing protocol, a route is selected based on the degree of association stability of mobile nodes. Each node periodically generates beacon to announce its existence. Upon receiving the beacon message, a neighbor node updates its own associativity table. For each beacon received, the associativity tick of the receiving node with the beaconing node is increased. A high value of associativity tick for any particular beaconing node means that the node is relatively static. Associativity tick is reset when any neighboring node moves out of the neighborhood of any other node.

Signal Stability Routing:-

Signal Stability-Based Adaptive Routing protocol (SSR) presented in is an on-demand routing protocol that selects routes based on the signal strength between nodes and a node's location stability. This route selection criterion has the effect of choosing routes that have "stronger" connectivity. SSR comprises of two cooperative protocols: the Dynamic Routing Protocol (DRP) and the Static Routing Protocol (SRP).The DRP maintains the Signal Stability Table (SST) and Routing Table (RT). The SST stores the signal strength of neighboring nodes obtained by periodic beacons from the link layer of each neighboring node. Signal strength is either recorded as a strong or weak channel. All transmissions are received by DRP and processed. After updating the appropriate table entries, the DRP passes the packet to the SRP.The SRP passes the packet up the stack if it is the intended receiver. If not, it looks up the destination in the RT and forwards the packet. If there is no entry for the destination in the RT, it initiates a route-search process to find a route. Route-request packets are forwarded to the next hop only if they are received over strong channels and have not been previously processed (to avoid looping). The destination chooses the first arriving route-search packet to send back as it is highly likely that the packet arrived over the shortest and/or least congested path. The DRP reverses the selected route and sends a route-reply message back to the initiator of route-request. The DRP of the nodes along the path update their RTs accordingly.Route-search packets arriving at the destination have necessarily arrived on the path of strongest signal stability because the packets arriving over a weak channel are dropped at intermediate nodes. If the source times out before receiving a reply then it changes the PREF field in the header to indicate that weak channels are acceptable, since these may be the only links over which the packet can be propagated.When a link failure is detected within the network, the intermediate nodes send an error message to the source indicating which channel has failed. The source then sends an erase message to notify all nodes of the broken link and initiates a new route-search process to find a new path to the destination.

Conclusion:-

Mobile ad-hoc networks (MANETs)are autonomously self organised networks without infrastructure support.In this article, several existing routing protocols for ad hoc Wireless Networks were described. Two categories of routing protocols were discussed. Table-driven and on-demand routing protocols. In table-driven protocols, each node maintain up-to-date routing information to all the nodes in the network where in on-demand protocols a node finds the route to a destination when it desires to send packets to the destination.Several table-driven protocols were discussed. DSDV is table-driven protocols that use destination sequence numbers to keep routes loop-free and up-to-date. CGSR is a cluster-based routing protocol where nodes are grouped into clusters.On-demand routing protocols were also discussed. In on-demand protocols, a route creation is initiated by the source when the source wants to communicate to the destination. AODV on-demand version of DSDV routing protocol. ABR uses the degree of associativity to select routes. Similarly, SSR selects routes based on signal strength.

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