Overview of Routing Protocols in Wireless Local Area Networks

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Abstract: This work x-rays the overview of routing protocols in wireless local area network (WLAN). Wireless network comprises of many applications in mobile computing systems, laptops, IPADs and PDAs, which are dynamically and arbitrarily interconnected. These systems are capable of changing state on a regular basis, thereby altering the existing network physical and logical topologies. Hence the need for convergence by a standard routing protocol is needed. This work takes an overview of some important routing protocols used in WLAN by categorizing them in terms of their characteristics and functionality, efficient route discovery mechanisms, and comparison of their respective merits and demerits in a wireless local area network (WLAN). Some of the important routing protocols classifications as used in WLAN include – proactive (table-driven), reactive (on-demand), power aware, hierarchical and geographical multicast routing protocols etc.

Keywords - Wireless Local Area Networks (WLANs), routing protocols (Algorithm), proactive routing, reactive routing, hybrid routing, dynamic topology.

I.   INTRODUCTION

A network is a collection of two or more computing units that are linked together by a communication medium. This forms the bedrock of what is categorized as conventional and wireless networks – wireless local area network.

Wireless local area network (WLAN), is a type of network that links two or more computing devices using distribution technique (typically- spread spectrum or orthogonal frequency division multiplexing, OFDM), usually providing connection through an Access Point (AP) to the wider internet. Most modern WLANs are based on IEEEs 802.11 standard, marketed under the Wi-Fi brand name [1].

Wireless Networks
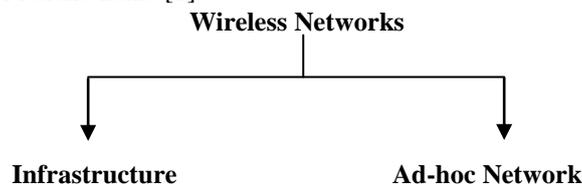
Infrastructure　　　　　**Ad-hoc Network**

Fig. 1: Types of Wireless Network

In wireless network, there are two types: The first is the infrastructure network (i.e. a network with fixed and wired gateways). The bridges for these networks are known as base stations. A mobile unit within these networks connects to, and communicates with, the nearest base station that is within its communication radius. Typical application of this type of network includes office wireless local area networks (WLANs). The second type is the Infrastructure less (ad hoc). In infrastructure less network, it has no fixed routers; all nodes are capable of movement and can be connected dynamically in an arbitrary manner. Nodes of these networks function as routers which discover and maintain routes to other nodes in the network. Ad hoc networks are very useful in emergency search-and-rescue operations, meetings and conventions, in which persons quickly wish to share information, and data acquisition operation in hospital terrain [2].

For computing units to communicate; exchange packets and discover routes to destination hosts, there is need for standards that are acceptable to all computing units across the wireless network. Such standards are called "Routing protocol". Routing protocol distributes routing information throughout all the routers on a network. It oversees route discovery, route maintenance, convergence of network topology, harmonized exchange of packets within the network etc, and using wireless RF transceiver as their network interface.

II.   PROBLEM STATEMENT

This work evaluated major routing protocols used in WLAN. Discussions on the performance analysis of routing protocols are considered. Routing in the mobile ad-hoc networks (MANETs) is a challenging task and has received a tremendous amount of attention from researchers. This has led to the development of many routing protocols for MANETs.

III.   REVIEW OF RELATED RESEARCH EFFORT

Mobile Ad hoc network (MANET) routing protocols are classified according to several criteria, reflecting fundamental design and implementation choices [3]. Numerous routing protocols have being proposed and developed for ad hoc networks. Such protocols must deal with limited resources available with these networks, which include high power consumption, low bandwidth, and high mobility. An intelligent routing algorithm is required to efficiently use these limited resources while at same time being adaptable to the changing network conditions such as network size, traffic density, network topology and broken routes [4].

P. Jacquet et. al. [5] proposed a proactive routing protocol for mobile ad hoc networks (MANETs), which they *called Optimized Link State Routing (OLSR).* The protocol inherits the stability of the link state algorithm. Due to its proactive nature, it has advantage of having the routes immediately available when needed. OLSR protocol is an optimization of a pure link state protocol for MANETs, which is done in two ways; Firstly, it reduces the size of control packets. Secondly, it minimizes flooding of this control traffic by using only the selected nodes called Multipoint Relay, to diffuse its messages in the network.

C. Perkins et. al.[6] modeled a routing method, *Destination-sequenced distance vector (DSDV)*, that allows a collection of mobile computers, which may be far from any base station, that can exchange data along changing and arbitrary paths of interconnection. The computers must also exchange control messages so that all computers in the collection have a (possibly multihop) path along which data can be exchanged. This solution remains compatible with operation in cases where a base station is available.

E. Royer et. al. [7] designed a method *called a pure On-Demand route acquisition* system; nodes that do not lie on active path, neither maintain any routing information nor participate in any periodic routing table exchanges. They stated that a does not have to discover and maintain a route to another node until the two need to communicate, unless the former node is offering its services as an intermediate forwarding station to maintain connectivity between two other nodes. The algorithm's primary objectives are: to broadcast discovery packets only when necessary; to distinguish between local connectivity management (neighborhood detection) and general topology maintenance; and to disseminate information about changes in local connectivity to those neighboring mobile nodes that are likely to need the information.

V. Park et. al. [8] Temporally-Ordered Routing Algorithm (TORA) routing protocol, was designed to work on top of lower layer mechanisms or protocols that provide the following basic services between neighboring routers: Link status sensing and neighbor discovery; reliable, in-order control packet delivery; Link and network layer address resolution and mapping; and Security authentication.

Events such as the reception of control messages and changes in connectivity with neighboring routers trigger TORA's algorithmic reactions. TORA assigns directions to the links between routers to form a routing structure that is used to forward datagram to the destination. Basically, TORA can be separated into four basic functions: creating routes, maintaining routes, erasing routes, and optimizing routes. It accomplishes these four functions through the use of four distinct control packets: query (QRY), update (UPD), Clear (CLR), and optimization (OPT).

Any MANET routing protocol exhibits two types of properties:

- ▪ Qualitative, such as loop freedom, security, demand based routing, distributed operation, multi-path routing etc
- ▪ Quantitative, such as throughput, delay, route discovery time, packet delivery ratio, jitters etc [4].

IV.   CLASSIFICATION OF ROUTING PROTOCOLS IN WLANs

The need for routing protocols in a wireless network cannot be overemphasized. Many routing protocols have been designed to mitigate and correct some topological changes that may occur as a result of dynamic and arbitrary nature of MANETs. Each routing protocol is designed for a peculiar functions and characteristics with proposed improvement on the existing protocol. Application of a routing protocol shows the need for a particular function and/or feature. Many studies have been carried out to have an overview of all routing protocols used in WLAN in order to define set of protocols that can enhance the bandwidth utilization, minimum energy consumption, higher throughputs, less overhead cost etc.

Wireless Local Area Network Routing Protocols

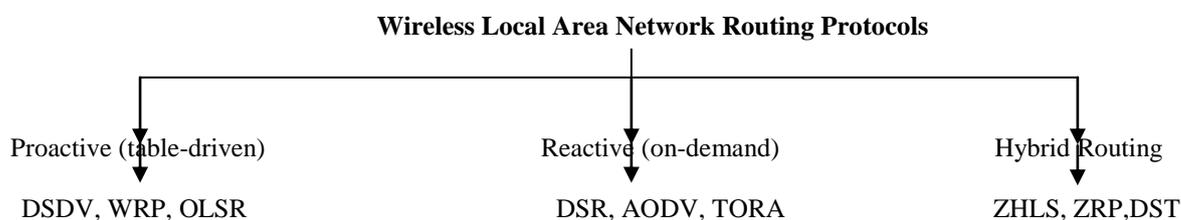| Proactive (table-driven)	Reactive (on-demand)	Hybrid Routing
DSDV, WRP, OLSR	DSR, AODV, TORA	ZHLS, ZRP,DST

Fig. 2: Classification of Wireless Local Area Network Routing Protocols

We will take an overview of the proposed routing protocols as classified above, their characteristic features, mode of operation and types. This is classified into three major categories based on the routing information update method.

V.   PROACTIVE ROUTING PROTOCOL (Table-Driven):

In this type of routing protocol, each node maintains one or more routing tables which are updated regularly. Each node sends a broadcast message to the entire network if there is a change in the network topology. However it incurs additional overhead cost due to maintaining up-to-date information and as a result throughput of the network may be

affected, but it provides the actual information to the availability of the network. Some of different types of table-driven protocols are: Destination sequenced distance vector routing (DSDV), Wireless routing protocol (WRP), Optimized link state routing protocol (OLSR), Source tree adaptive routing protocol (STAR), Global state routing protocol(GSR),etc.

Destination sequenced distance vector routing (DSDV): is one of the early routing protocols developed. It is based on the Routing Information Protocol (RIP). In DSDV packets are routed between nodes of an ad hoc network using routing table stored at each node. The bulk of the DSDV protocol does not involve in routing; rather, the crux of DSDV is the generation and maintenance of the routing tables. The main weaknesses found in DSDV are: the overhead cost and inability to manage high rate of node mobility.

Wireless Routing Protocol (WRP): is a table based protocol similar to DSDV that inherits the properties of Bellman-Ford Algorithm, as stated in [9]. WRP uses an enhanced version of the distance-vector routing protocol, which uses the Bellman-Ford algorithm to calculate paths. It is a loop-free routing protocol that eliminates looping situations and enables faster route convergence when link failure occurs. In WRP, each node in the network uses a set of four tables to maintain more accurate information: distance table (DT), routing table (RT), link-cost table (LCT), and message retransmission list (MRL) table. The DT contains the network view of the neighbors of a node. The RT contains the up-to-date view of the network for all known destinations. The LCT contains the cost (e.g., the number of hops to reach the destination) of relaying messages through each link. The MRL contains an entry for every update message that is to be retransmitted and maintains a counter for each entry.

Optimized Link State Routing (OLSR): protocol as proposed by Jacquet and Clausen is a point-to-point proactive protocol that employs an efficient link state packet forwarding mechanism called *multipoint relaying*. It inherits the stability of the state algorithm. It proactively provides the routes immediately when it's needed. OLSR optimizes the pure link state in two ways: by reducing the size of the control packets and by reducing the number of links used for forwarding the link state packets. This technique significantly reduces the number of retransmissions in a flooding or broadcast procedure [5], [10].

Source Tree Adaptive Routing Protocol (STAR): nodes in STAR communicates to their neighbors; source routing tree during initialization incrementally, as well as update messages about new destinations, chances of routing loops, costs of paths. Every node broadcasts its source-tree information to wireless links used by the node in its preferred path to destinations [9]. This protocol has significantly reduced the amount of routing overhead disseminated into the network by using a least overhead routing approach (LORA), to exchange routing information. The optimum routing (ORA) approach obtains the shortest path to the destination while LORA minimizes the packet overhead [10].

Global state routing protocol (GSR): GSR is a table-driven protocol that uses destination sequence numbers to keep routes loop-free and up-to-date similar to DSDV. In [9] GSR 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. 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.

Summary

In table-driven protocols, nodes maintain and exchange routing information regularly to other nodes within the network. Here there exist two classes of routing protocols: one class is the distance vector protocol where the nodes maintain only a local topology, and uses the distributed Bellman-Ford algorithm to maintain the routing table; the second protocol is the link state routing protocol, where the full topology information is exchanged within the network. These classes of protocols differs in a number of ways: the way routing information is detected and updated, the number of routing tables employed, the type of information stored in each table, and the changes that are periodically broadcast in the network. Basically, table-driven protocols enjoy one main advantage; the routing information is readily available for nodes to initiate a session. As a result, nodes encounter high overhead cost in order to maintain routes and as such, convergence takes much time when there is a link failure.

VI. REACTIVE ROUTING PROTOCOLS (On-demand):

On-demand routing protocols are designed to reduce the overheads in proactive protocols by maintaining information for active routes only. This means that routes are determined and maintained for nodes that require sending data to a particular destination. Route discovery usually occurs by flooding a route request packet within the network. Reactive protocols can be classified into two categories: source routing and hop-by hop routing. In source routed on-demand protocols, each data packet carries the complete source to destination address. This means that intermediate nodes need not to maintain up-to-date routing information for each of the active route in order to forward the packet toward the destination. Furthermore, for hop-by-hop routing nodes do not need to maintain neighbor connectivity through periodic beaconing messages. [11]. Reactive routing protocols include:

Dynamic Source Routing (DSR), Ad hoc On-demand Distance Vector (AODV), Temporally Ordered routing Algorithm (TORA), Associativity- Based Routing (ABR), and Signal Stability Routing (SSR).

Dynamic Source Routing (DSR): is a loop-free, source based, on-demand routing protocol, where each node maintains a route cache that contains the source routes learned by the node. There are two major phases in DSR: *route discovery* and *route maintenance*. The route discovery process is only initiated when a source do not already have a valid address to the destination in its route cache; entries in the route cache are continually update as new routes are learned. Source routing

is used for packet forwarding [3], [4]. DSR was designed for multi hop networks for small Diameters. It is a beaconless protocol in which no HELLO messages are exchanged between nodes to notify them of their neighbors in the network.

Ad Hoc On-Demand Distance Vector Routing (AODV): [10], [7] AODV is widely on-demand routing protocol in ad hoc network proposed by C.E Perkins and E.M Royer. AODV is a combination of both DSR and DSDV. It follows the basic on-demand mechanism of route discovery and route maintenance DSR, plus use of hop-to-hop routing, sequence number, and periodic beacons from DSDV. It uses destination sequence number to ensure loop freedom at all times and by avoiding the Bellman-Ford "count-to-infinity problem, offers quick convergence when the ad hoc network topology changes. AODV uses a broadcast route discovery mechanism as is used in DSR algorithm. Instead of source routing, however, AODV relies on dynamically establishing route table entries at intermediate nodes.

Temporally-Ordered Routing Algorithm (TORA): TORA is a highly adaptive loop-free distributed routing algorithm based on the concept of *link reversal*. It is designed to discover routes on demand, provide multiple routes to a destination, establish routes quickly, and minimize communication overhead by localizing the reaction to topological changes when possible. TORA is proposed to operate in a highly dynamic mobile networking environment. It is source-initiated and provides multiple routes for any desired source/destination pair. The protocol performs three basic functions: route creation, route maintenance, and route erasure [2], [12].

Associativity-Based Routing (ABR): [13] 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. It is free from loops, deadlock, and packet duplicates and defines a new routing metric for ad hoc mobile networks. 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. A fundamental objective of ABR is to derive longer-lived routes for ad hoc mobile network.

Signal Stability–Based Adaptive Routing Protocol (SSA): SSA [13] protocol focuses on obtaining the most stable routes through an ad hoc network. The protocol performs on demand route discovery based on signal strength and location stability. Based on the signal strength, SSA detects weak and strong channels in the network. SSA can be divided into two cooperative protocols: the Dynamic Routing Protocol (DRP) and the Static Routing Protocol (SRP). DRP uses two tables: Signal Stability Table (SST) and Routing Table (RT). SST stores the signal strengths of the neighboring nodes obtained by periodic beacons from the link layer of each neighboring node. These signal strengths are recorded as weak or strong. DRP receives all the transmissions and, after processing, it passes those to the SRP. SRP passes the packet to the node's upper layer stack if it is the destination. Otherwise, it looks for the destination in routing table and forwards the packet. If there is no entry in the routing table for that destination, it initiates the route-finding process through route request packet. One disadvantage of SSA when compared to DSR and AODV is that intermediate nodes cannot reply to route requests sent toward a destination, which may potentially create long delays before a route can be discovered. This is because the destination is responsible for selecting the route for data transfer. Another disadvantage of SSA is no attempt is made to repair routes at the point where the link failure occurs (i.e. such as an LBQ in ABR). In SSA the reconstruction occurs at the source. This may introduce extra delays, since the source must be notified of the broken like before another one can be found [11].

Summary

The reactive protocols are considered to have same mechanisms used for route discovery and route maintenance. The source node sends a request packet to discover a route to the destination node, by flooding packet to all nodes in the network. The route paths followed by the request packet are saved and sent back to the source node by the final destination node. Note also that, as the request packet is flooded it generates multiple reply packets, which in turn yield multiple paths- of which the shortest path is to be used. The advantage of this strategy is that routes are adaptable to the dynamically changing environment of MANETs, since each node can update its routing table when they receiver fresher topology information and hence forward the data packets over fresher and better routes. Using fresher routes also means that fewer route recalculations are required during data transmission. The disadvantage of this strategy is that each intermediate node must store and maintain routing information for each active route and each node may require being aware of their surrounding neighbors through the use of beaconing messages. Therefore, as the name implies – On-demand (reactive), routing information is only made available when it is needed, hence no periodic updates are required.

VII.   HYBRID ROUTING PROTOCLS

Hybrid routing protocols are a new generation of protocol, which are both proactive and reactive in nature. These protocols are designed to increase scalability by allowing nodes with close proximity to work together to form some sort of a backbone to reduce the route discovery overheads. This is mostly achieved by proactively maintaining routes to nearby nodes and determining routes to far away nodes using a route discovery strategy. Most hybrid protocols proposed to date are zone-based, which means that the network is partitioned or seen as a number of zones by each node [11]. The difficulty of all hybrid routing protocols is how to organize the network according to network parameters. The common disadvantage of hybrid routing protocols is that the nodes that have high level topological information maintains more routing information, which leads to more memory and power consumption [10]. Some examples of hybrid routing protocol include: Zone Routing Protocol (ZRP), Zone-Based Hierarchical Link State (ZHLS), Sharp Hybrid Adaptive Routing Protocol (SHARP), and Distributed spanning trees based routing protocol (DST).

Zone-Based Hierarchical Link State (ZHLS): ZHLS [10] is based on hierarchical structure in which the network is divided into non-overlapping zones. Each node is assigned one unique node ID and a zone ID, which are calculated using geographical information. Hence the network follows a two-level topology structure: node level and zone level. Respectively, there are two types of link state updates: the node level LSP (Link State Packet) and the zone level LSP. A node level LSP contains the node IDs of its neighbors in the same zone and the zone IDs of all other zones. A node periodically broadcast its node level LSP to all other nodes in the same zone. Therefore, through periodic node level LSP exchanges, all nodes in a zone keep similar node level link state information. Before transmission, the source node first checks its intra-zone routing table. If the destination lies in its zone, the routing information is already present. Otherwise, the source sends a location request to all other zones through gateway nodes, which in turn replies with a location response containing the zone ID of the desired destination. ZHLS has a low routing overhead as compared to AODV and DSR. Also the routing path is adaptable to the dynamic topology as only node ID and zone ID are required for routing.

Zone Routing Protocol (ZRP): In ZRP [11], the nodes have a routing zone, which defines a range (in hops) that each node is required to maintain network connectivity proactively. Therefore, for nodes within the routing zone, routes are immediately available. For nodes that lie outside the routing zone, routes are determined on-demand (i.e. reactively), and it can use any on-demand routing protocol to determine a route to the required destination. The advantage of this protocol is that it has significantly reduced the amount of communication overhead when compared to pure proactive protocols. It also has reduced the delays associated with pure reactive protocols such as DSR, by allowing routes to be discovered faster. The disadvantage of ZRP is that for large values of routing zone the protocol can behave like a pure proactive protocol, while for small values it behaves like a reactive protocol.

Sharp Hybrid Adaptive Routing Protocol (SHARP): SHARP [13] adapts between reactive and proactive routing by dynamically varying the amount of routing information shared proactively. This protocol defines the proactive zones around some nodes. The number of nodes in a particular proactive zone is determined by the node-specific zone radius. All nodes within the zone radius of a particular node become the member of that particular proactive zone for that node. If for a given destination a node is not present within a particular proactive zone, reactive routing mechanism (query-reply) is used to establish the route to that node. Proactive routing mechanism is used within the proactive zone. Nodes within the proactive zone maintain routes proactively only with respect to the central node. In this protocol, proactive zones are created automatically if some destinations are frequently addressed or sought within the network. The proactive zones act as collectors of packets, which forward the packets efficiently to the destination, once the packets reach any node at the zone vicinity.

Distributed spanning trees based routing protocol (DST): In DST nodes in the network are grouped into a number of trees [10]. Each tree has two types of nodes; route node, and internal node. The root controls the structure of the tree and whether the tree can merge with another tree, and the rest of the nodes within each tree are the regular nodes. Each node can be in one three different states; router, merge and configure depending on the type of task that it trying to perform. DST proposes two strategies to determine a route between a source and a destination pair: *Hybrid Tree Flooding (HTF):* In this scheme, the source sends the control packets to all the neighbors and adjoining bridges in the spanning tree. Each packet is remained static at these places for a specific holding time. *Distributed Spanning Tree (DST) shuttling:* In this approach, the source sends the control packets to the tree edges till each of them reaches a leaf node. When a packet reaches the leaf node, it is forwarded to a shuttling level. The drawback with such architecture is the existence of a single point of failure for the entire tree. If the root node fails, the entire routing structure falls apart. Furthermore, the holding time used to buffer the packets may introduce extra delays in to the network.

Summary

Based on the overview of some of the hybrid routing protocols, it can be seen that these protocols are a new generation of protocols which were created from the combination of some features of reactive and proactive routing protocols. They are used to provide hierarchical routing and higher scalability - compared to table-driven and on-demand protocols. They attempt to reduce the number of rebroadcasting nodes by restructuring how routing is performed. The protocols have been proposed to eliminate single point of failure and creating bottleneck nodes in the network, which is achieved by allowing any number of nodes to perform routing or data forwarding if preferred path is unavailable. The difficulty of all hybrid routing protocols is how to organize the network according to network parameters. The common disadvantage of hybrid routing protocols is that the nodes that have high level topological information maintains more routing information, which requires more memory and power consumption. Out of these ZRP combines the best features of both reactive and proactive routing protocols.

VIII. PREVIEW OF OTHER ROUTING PROTOCOL

Xiaojing et al [14] propose an efficient ***geographic multicast protocol (EGMP)***. EGMP can scale to large group size and network size and can efficiently implement multicasting delivery and group membership management.

EGMP uses a hierarchical structure to achieve scalability. The network terrain is divided into geographical non-overlapping square zones, and a leader is elected in each zone to take charge of the local group membership management. A zone-based bi-directional multicast tree is built in the network range to connect those zones having group members, and such tree-structure can utilize the network resource efficiently.

Geographical routing protocols [15] refer to a set of protocols that employs geographical information for the purpose of routing and data forwarding. Geographical routing protocol scales better for ad hoc network mainly for two reasons: (i) there is no necessity to keep routing table up-to-date, and (ii) no need to have a global view of the network topology

and its changes. Those geographic approaches allow routers to be nearly stateless because forwarding decisions are based on location information of the destination and location information of all one hop neighbors. No routing table is constructed. As a result, establishment and maintenance of routers are not required, hence reducing overhead considerably.

Power aware routing protocols, [7] the nodes in MANETs are typically powered by batteries with limited energy supply. One of the most challenging issue in MANETs is how to conserve energy, and maximize the life of its nodes, thus of the network itself. Some routing algorithms have designed to check these challenges. They are:

- Minimum Total Transmission Power Routing (MTTPR) is a basic power aware routing protocol that always tries to minimize the total power of the entire network by selecting the minimum hop count route. This actually implements the metric "minimize the energy consumed per packet".
- Minimum Battery Cost Routing (MBCR), the MTTPR algorithm does not take care of battery life of every individual node, so MBCR algorithm is proposed by introducing extra battery cost function, that is, the inverse of the remaining battery capacity. This means, if the remaining battery power decreases, the cost function will increase. This algorithm first finds the battery for each node of the network, and then finds the battery cost function.

IX. COMPARISON BETWEEN DIFFERENT ROUTING PROTOCOLS USE IN WLAN

The table I shows the comparison of the various protocols, basically in terms of classifications, routing characteristics as well as efficiency in application in proactive routing protocol.

TableI: comparison of proactive routing protocols

Parameters	DSDV	WRP	OLSR
Route update	Periodic	Periodic	Periodic
Loop-free Routing	Yes	Yes	Yes
Overhead Caching	High	High	Low
Overhead	Medium	High	High
Throughput	Low	Low	Medium
Routing Table	2	4	4

The table II shows some of the reactive routing protocols that have been proposed to increase the performance of reactive routing.

The table compares a number of these strategies and makes a performance comparison between them. These include– summary of the characteristic feature of each strategy and theoretical performance evaluation.

Table II: comparison of reactive routing protocols

Parameters	AODV	DSR	TORA
Route Creation	By source	By source	Locally
Periodic Updation	No	No	No
Performance Metric	Speed	Shortness	Speed
Routing Overhead	High	High	High
Caching Overhead	Low	High	Medium
Throughput	High	Low	Low
Multipath	No	Yes	Yes
Route Updation	Non-periodic	Non-periodic	High routing overhead

Table III compares the overall performance of proactive, reactive and hybrid routing protocols. A glance at the table shows characteristic features of each strategy as employed by each category of the routing protocols.

Table III: comparison of major categories of routing protocol

Parameters	Table-Driven (Proactive)	On-Demand (Reactive)	Hybrid
Storage Requirement	Higher	Dependent on no. of routes maintained or needed	Depends on size of each zone or cluster
Route Availability	Always available	Computed as per need	Depends on location of destination
Periodic route update	Required always	Not required	Used inside each zone
Delay	Low	High	Low for local destination and higher for interzones
Scalability	100 nodes	> 100	> 1000
Control traffic	High	Low	Lower than other types
Routing information	Keep stored in table	Doesn't store	Depends on requirement

Routing philosophy	Mostly flat	Flat	Hierarchical

X.   DEDUCTIONS

Although, **Reactive protocols** do not have the fixed overheads, but still there exist some disadvantages. One of them is that a large amount of time is wasted finding routes. The other disadvantage is in case of excessive flooding, there might be a possibility of network clog or failure.

The disadvantage of **proactive protocols** is too much data stored by the nodes for route maintenance and it does not converge fast when there is a failure in a particular node link. The disadvantage associated with all the hierarchical protocols in wireless network is mobility management. Mobility management introduces unnecessary overhead to the network (such as extra processing overheads for cluster formation and maintenance).

In **Hybrid routing protocols** shows a common disadvantage, the nodes that have high level topological information maintains more routing information, which requires more memory and power consumption. These protocols have the great potential to provide higher scalability than the other two classes.

XI.   CONCLUTIONS

This work takes an overview of number of routing protocols used in wireless network. Classifications were drawn based on the routing characteristics and performance, application content, and functions. Comparison of different routing protocols were discussed, which are divided into three main categories: (i) source-initiated (reactive or on-demand), (ii) table-driven (pro-active), (iii) hybrid protocols. Each of these protocols was reviewed and analyzed. Each provides unique features that deal with inherent challenges encountered in ad hoc wireless network such as infrastructure deficit, ever-changing topologies as well as network security. One factor that was outstanding in differentiating among these protocols was the pattern of finding and maintaining the route between source-destination pair. The overview as presented in this work will go a long way in providing a platform for anyone to choose the best protocol for his/her work.

ACKNOWLEDGMENT

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