CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

The communication between human beings with the aid of technological development has evolved in various stages. Wired and wireless network models are the two major communication models that facilitate the people engaged in their remote communication. Deng et al (2002) stated that the wireless model itself has two major classifications. The one is wireless model with fixed backbone architecture and another one is a mobile ad-hoc network model.

The wireless model with fixed backbone architecture consists of a huge number of Mobile Nodes (MNs) and few powerful fixed nodes. Though the communication between a fixed node and a MN is occurring with the help of the wireless medium, this needs a fixed infrastructure. Younis & Ozer (2006) described that MANET is a collection of mobile nodes that are organized by themselves to deploy a temporary and dynamic wireless network on a wireless medium. MANET requires neither a fixed infrastructure nor centralized administration. A communication takes place either by means of single hop transmission if the receiver is within the transmission range of the sender node or by hopping of few intermediate nodes if the receiver is out of transmission range. Because of that reason Junhai et al (2008) stated that

MANET also can be said to be multi-hop packet radio network. Due to absence of centralized administration and a limited transmission range of wireless network, each node in MANET acts both as a host and a router. Thus the one that acts a router forwards packet to other mobile nodes in the network and allows itself to identify the multi-hop route through network to any other node. The rapid development in MANET gets the researchers pose an eye on routing strategy of mobile nodes in the MANET. Various multicast routing protocols have been proposed in the literature. Few are proactive multicast routing protocol that determines the route in advance between any two nodes irrespective of the need in the future. In contrast, few are reactive protocols that explore the route only on demand. Some protocols consider all nodes fall under flat network topology while few others consider a hierarchy among nodes, only nodes in the same tire of the hierarchy are assumed as peers.

Some protocols are designed in such a way that each node in the network is aware of its current location as well as gets information about its neighbors and other nodes. Konglin et al (2011) proposed Geo-assisted Multicast Inter-Domain Routing (GMIDR) which is assisted by geographical assistance and clustering technology. Some multicast routing protocols are very much sensitive to available battery power at the nodes and the amount of energy to be spent in transmission session have also been proposed in the literature. There are some multicast routing protocols that determine and retain multi-paths for a given pair of node. Mohammad et al (2013) analyzed that the modelling of network connectivity in routing protocols for MANET and Vehicular Ad-hoc Network (VANET). In this chapter of the thesis an overview of typical multicast routing protocols for MANET is narrated. It is hardly possible to declare which routing protocol has better performance under prescribed condition. The main objective of this literature survey is to focus on grouping these protocols under different routing mechanism and classify to analyze the typical multicast routing protocols. Whatever may be the multicast routing protocols, they can be grouped under either application dependent or application independent multicast routing strategies.

2.2 ROUTING PROTOCOLS FOR MANET

There are two types of routing mechanism for MANET. The one is unicast routing and the other is multicast mechanism. For each mechanism several protocols have been developed.

2.2.1 Unicast Routing Protocols

In any data communication routing is the very primitive component. To obtain more practical and effective MANET application, routing is considered a serious issue. Chen &Wu (2003) stated that many types of unicast routing protocols have been designed and implemented for MANET. They fall under either proactive or reactive routing strategies. A proactive routing protocol maintains a table and so it is called as a table driven unicast routing protocol. Whenever a change in network topology occurs, it updates the table consistently to evaluate the route between source and destination. Therefore the source node is able to get routing information immediately if it requires one. In proactive routing protocols, all nodes have to keep on monitoring the network topology in order to maintain their table. Most of the proactive unicast protocols use the properties of algorithms used in wired networks. Shaik et al (2001) introduced the Optimized Link State Routing Protocol (OLSR) and Chou et al (2006) developed the Dynamic destination Sequenced Distance- Vector protocol (DSDV). They are some of the examples of proactive routing protocols for MANET. Khalil et al (2013) introduced the Authenticated Routing for Ad-hoc Networks (ARAN) which uses a distributive nature algorithm and stated that the performance of routing protocol increases when the area is split into a number of zones.

Another approach is reactive unicast routing also called as source initiated on demand unicast routing protocol. In this type the route is established only when the source node desires it. The route discovery mechanism is initiated to discover the route to destination once a node requires routing. The exploration continues until the route is discovered. All nodes in the topology are mobile in nature. Even active node may be disconnected. The route maintenance is a prime operation of reactive routing protocols. Marina & Das (2006) proposed Ad-hoc-On-demand Distance Vector Protocol (AODV) which is an example of reactive routing protocols. Reactive routing protocols suffer from less control overhead than proactive routing protocols. A high degree of scalability is achieved through reactive routing than proactive routing .Source nodes using reactive routing strategy suffer from the long delay for route discovery before they can send the packets.

2.2.2 Multicast Routing Protocols

It is very difficult to make use of the wired network in the areas where quick deployment and dynamic reconfiguration are very much essential. Applications of MANET in such areas like military battlefields, disaster relief operation, classrooms and group games where participants exchange information very often dynamically using their mobile devices are prevalent now a day. For the above said operation multicast routing plays an important role. It is cumbersome to reduce the transmission overhead and subsequent power consumption in wireless environment. Multicast routing becomes very much useful when it inherits the properties of broadcast wireless transmission. As far as wired environment is considered the shortest path multicast tree and core-based tree are the two well known network multicast approaches. The shortest path multicast tree ensures the shortest path to each destination. But in this approach source node has to build a tree. If there are so many trees in the network, overhead will also become larger. The core based tree builds only one tree for each group and hence it reduces the number of trees. Multicast routing in MANET has to address a lot of issues due to the characteristics such as mobility, low power and bandwidth. The bandwidth of MANET is lower than wired networks, so information collection cost is very high during construction of the routing table. Due to the dynamic nature of mobile node the underlying network changes its topology and also increases unavailability of network information.

Designing multicast routing protocols have become very attractive research areas. Chen & Wu (2003) viewed that there are three basic types of multicast routing mechanism in MANET. A basic method is a node in a network floods the messages and every node that receives messages again floods it to its neighbors. Flooding is just like a chain reaction that causes exponential growth. The second one is a proactive approach that predetermines the available path between source and destination and routing table is maintained now and then. Routing information is propagated periodically throughout the network in proactive approach. The third approach is reactive routing that discovers the route only on demand. The idea behind this approach is based on interrogative response mechanism.

A lot of multicast routing protocols have been proposed. Wu &Tay (1999) designed the Ad-hoc Multicast Routing protocol utilizing increasing Identification numbers (AMRIS) in which a shared tree is constructed to send multicast data. The identification number is used to assign each node in the multicast transmission. It changes the identification number according to network connectivity changes. Royer & Perkins (1999) developed the Multicast Ad-hoc-On-Demand Vector (MAODV) that makes a tree using the sequence destination number on each multicast entry. The multicast group head generates a sequence number in such a way that no loops are formed and delete unusable routes. Xie et al (2002) introduced the Ad-hoc Multicast Routing (AMRoute), which is a shared tree based protocol that permits dynamic core migration based on group membership management and network topology Ji & Corson (2011) proposed the Lightweight Adaptive Multicast (LAM) algorithm that does not require a message which is bound to timer. Gerla et al (2000) developed the On-Demand Multicast Routing Protocol (ODMRP) that used the concept given in LAM. Garcia & Madruga (1999) introduced the Core Assisted Mesh Protocol (CAMP) and designed based on a mesh structure that uses the vector algorithm to function.

In CAMP the nodes acting as a core is litigated to control the traffic required when a new node joins the multicast group. Chen & Nahrstedt, (2002) developed the Location Guided Tree (LGT) multicast routing protocol that used packet encapsulation and unicast routing protocol to construct multicast packet distribution tree. Ji, & Corson (2001) proposed the Differential Destination Multicast (DDM) and analyzed that flooding is limited within a chosen forwarding group. Most of the above said protocols are based on similarities of distance vector or link state routing with some more adding functionality to ease the routing operation. The main objectives of these protocols take account of diminished processing overhead, reduced control overhead, free from loop, dynamic topology maintenance and potential multi-hop routing. Achieving all these goals is very difficult in a dynamic wireless environment and hence multicast routing poses challenges. Martinez et al (2013) suggested that how geocast and multicast can be integrated to improve the efficiency of routing.

2.3 CHARACTERISTICS OF MULTICAST ROUTING PROTOCOLS

It is very obvious to know the characteristics of multicast routing protocols as it helps the scholar and designers to understand the protocols and to identify its relationship with others. The information obtained through knowing the characteristics of multicast routing is made useful for drafting the new multicast routing protocol for MANET.

2.3.1 Evaluation Principles for Multicast Routing Protocols

Many of the multicast routing protocols have been designed based on the assumption that they are physically flat network architecture with mobile nodes which have the homogeneous capability in view of network resources and computing power. In reality the above assumption is no longer valid because of the arrival of various mobile nodes with different configuration, capacity and mobility pattern. In architecture based multicast routing protocols, MANET has different types of mobile nodes to form a physically different ad –hoc network hierarchy.

Galatchi (2007) suggested that the Hierarchical QoS Multicast Routing Protocol (HQMRP) is an example of a typical hierarchical architecture. Ammari et al (2004) developed the location based multicast routing protocol that makes use of a global positioning system (GPS) to identify the geographical information of mobile nodes as and when needed. Each node in location based multicast routing protocols identifies its own location through the aid of GPS positioning service. The Figure. 2.1 portraits the types of location service available for location based multicast routing protocols as stated by Friedman & Kliot (2006).

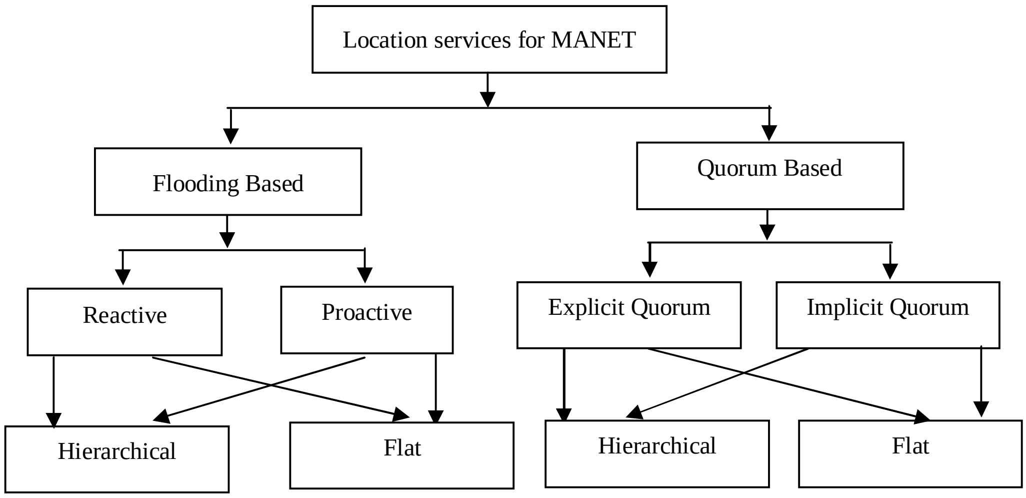

Figure 2.1 Types of location services for multicast routing protocols

The Location based Geocasting and Forwarding (LCF) and Robust Scalable Geographic Multicast (RSGM) are a few examples of location based multicast routing protocols developed by Latiff et al (2005) and Xiaojing et al (2010) respectively.

At the top level of categorization, location services for multicast protocol is split into flooding based and quorum based approaches. Flooding based protocols is further split into reactive and proactive approaches. In proactive flooding based multicast routing, destination node floods the information about its location at regular interval to the neighbor nodes in the network. Each node maintains a location table storing the current locations of other nodes. The interval and scope of flooding can be optimized with respect to nodes' mobility and distance factor. In reactive on demand flooding based multicast routing approaches, the node floods the query second time to the destination if it does not get the recent location of the destination to which it tries to send a packet in the first attempt. In quorum based multicast routing protocols, all nodes irrespective of sender or receiver agree upon a mapping that links with the unique identifier of each node to other nodes in the network. In the explicit quorum based approach, location update of a node is sent to a subset that defined already explicitly for all available nodes using update quorum, and a query about the location of that node is sent to various subsets using query quorum. In the implicit quorum based protocols, location servers are selected using hashing function.

2.3.2 Performance Criteria for Multicast Routing Protocols

Even though many protocols for multicast routing have been introduced for MANET, an environment with various network sizes, different mobility condition and drastic change in traffic overloads cannot be satisfied by a single best multicast routing protocol. It is meant that no single protocol can work well for all varieties of set up. Moreover multicast routing protocols have been designed with different philosophies to meet the specific requirements of environment where it is likely to be implemented. Therefore performance of a multicast routing protocol may differ with respect to varying network size and traffic overhead. It is tedious to give a wide range of performance analysis for all multicast routing protocols.

The performance of multicast routing protocols can be analyzed and compared by three major ways. The one is based on user parameter and configurations. In this throughput, control overhead, average multicast degree, multicast service cost and average delay are used to assess the performance of various multicast routing protocols. The second is based on different updating method where the routing table in the nodes is updated in three different ways. They are store and update, remove and refresh and the service provided by the unicast routing protocol to route updating. The third is based on different simulation tools where the performance is assessed by various simulation tools available, namely Network Simulator version 2 (NS-2), Signal Processing

Workstation (SPW), CASSAP, Global Mobile Simulation Library (GloMoSim), Opnet and Matlab.

2.4 CLASSIFICATION OF MULTICAST ROUTING PROTOCOLS

Most of the routing protocols for MANET have inherited the properties of the algorithm available for wired networks. The main objective of MANET is to increase the degree of mobility and perform the operation in an ad-hoc manner. Based on working principles all of these protocols can be grouped under any one of the route selection categories out of two basic broad views. Their views are application independence and application dependence. MANET is the extensive application of wired network, but they are used for specific purposes. The classification of multicast routing protocols is depicted in the Figure 2.2.

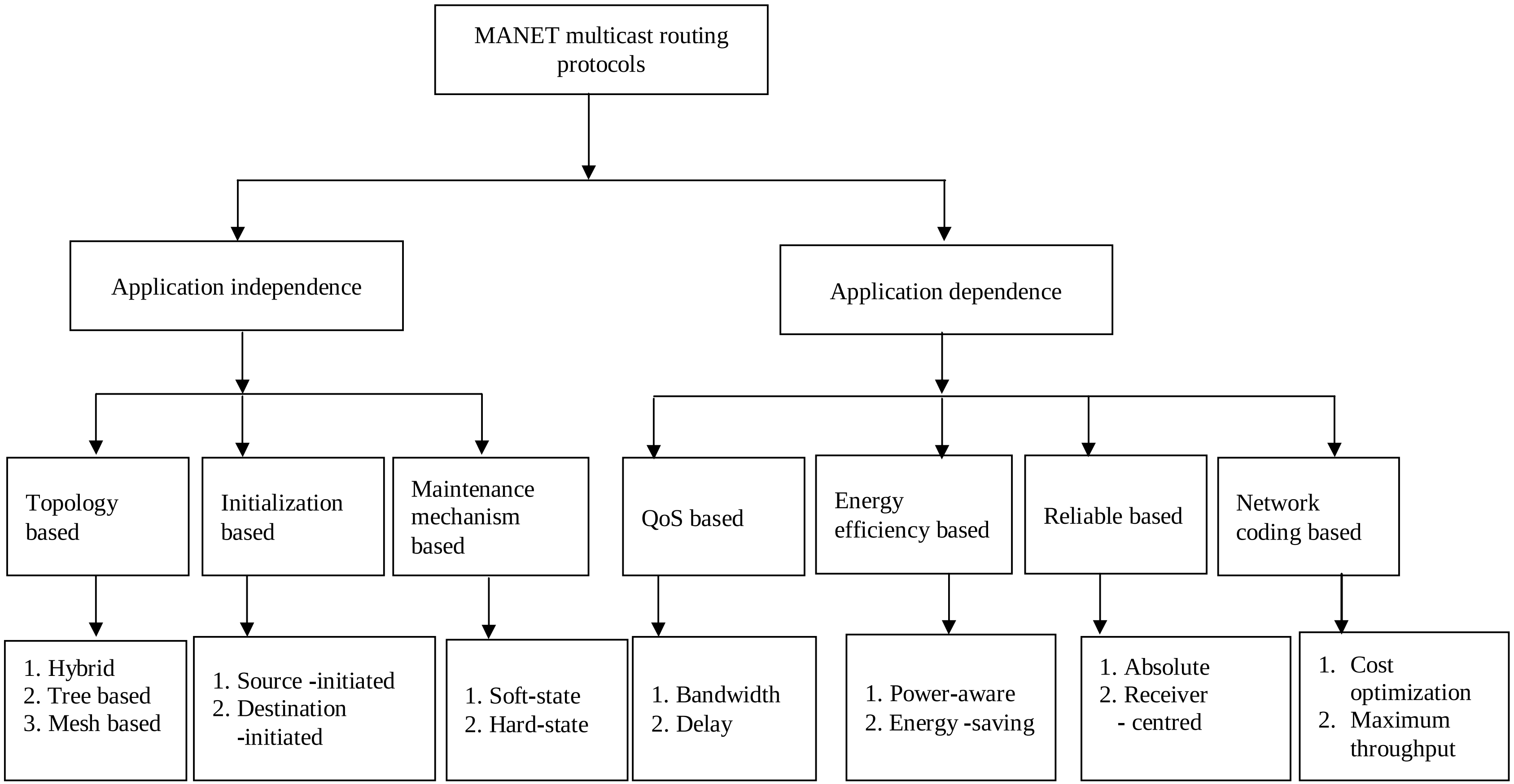

Figure 2.2 Classification of multicast routing protocols

2.4.1 Application Independent Multicast Routing Protocols:

Most of the application independent multicast routing protocols emerge from conventional multicast routing protocols for wired environment where the shortest path multicast tree and the core base tree are two major types. Many of the application independent multicast routing protocols for MANET use hop count as a metric. If there are a number of routs available in the network, the route with minimal hop count is chosen. If the failure probability for all wireless links is more common then the shortest routing path is more lasting than the longest path. Therefore the shortest path diminishes traffic overhead and decrease packet collisions. Application independent routing protocols for MANET can be further split into topology, initialization and maintenance mechanism based multicast routing.

2.4.1.1 Topology based multicast routing

One of the accepted methods to differentiate multicast routing protocols for MANET is based on how route delivery paths among the group members are built. In view of this method, the protocols that have been introduced so far can be further divided into tree based, mesh based and hybrid based multicast routing protocols. Again tree based multicast routing is divided into two types. They are source rooted and core rooted mechanism with respect to roots of the multicast trees. In a tree based source rooted multicast routing protocol, source nodes act as roots of the multicast tree and invoke the algorithm for route delivery path construction and maintenance. This source node must know about the topology information and possess the address of all its receivers. The protocols under this category involve heavy control overhead when they are engaged in a dynamic topology environment. AMRoute is an example for tree based source rooted protocol.

In tree based core rooted multicast routing protocols the nodes that take additional responsibility such as control data distribution and group membership management are said to be the core. A few protocols of this type also use the tree structure but perform different functions for group management and multicast data distribution. Canourgues et al (2006) developed the Shared Tree Ad-hoc Multicast Protocol (STAMP) and Kaliaperumal (2005) designed the Adaptive Core-based Multicast Routing Protocol (ACMP) are some of the examples for the tree based core rooted multicast routing .The tree based protocols constructs a single path between any pair of nodes in the multicast group. These protocols need a minimum number of replicas per packets that are sent along the multicast tree. They are bandwidth efficient and considerably power efficient. Configuration of the entire tree is iterated more often once link failure occurred due to increase in node mobility. If there are many sources, it is necessary either to retain a shared tree or maintain multiple trees which results in more control overhead and storage. Kant & Awathi (2010) suggested a stable link based multicast routing scheme, which stated that how the simultaneous delivery of data packets can be done to several destinations without any duplications and aiming at resource utilization.

In a mesh based multicast routing protocol, there are more than one path between a source –receiver pair. Nodes in the mesh structures are interconnected. Route exploration and mesh construction are established in two ways. One is broadcasting method to identify routes. Another is centralized core for mesh construction. The mesh based protocols provide high robustness as they offer multiple paths from source to destinations. In order to withstand the mesh topology, additional control packets are required than tree based approach as replica of the same data packet are sent through different paths available in the mesh. Therefore mesh topology suffers from power inefficiency and network control overhead. Dhillon & Ngo (2005) developed the Consolidated Query Packets (CQMP), and Oh et al (2005) designed the Enhanced On-Demand Multicast Routing Protocol (E-ODMRP) and Inn &Seah (2006) introduced the Bandwidth Optimized and Delay Sensitive (BODS). These are few examples for mesh based multicast routing protocols for MANET .

Hybrid based multicast routing protocols experience both the merits of tree and mesh based approaches. They take care of bandwidth efficiency and robustness. By this approach multiple routing paths are created, multiple copies can arrive at a receiver through different paths. Due to node mobility optimal tree construction is hardly possible. Biswas et al (2004) developed the Efficient Hybrid Multicast Routing Protocol (EHMRP) which is an example of hybrid based multicast routing protocol .

2.4.1.2 Initialization based multicast routing

The multicast group formation or multicast session is either created by a source or a receiver. In a network some nodes may join a multicast group and some may not join the group. Multicast group must be formed in such a way that nodes which are not interested to join as a member of the group should not be disturbed. This may be of sender initialization or receiver initialization. If the group is triggered by source node then the initialization is called sender initiated routing protocol. Here each packet transmitted by a sender is recognized by each receiver as suggested by Hui et al (2014). The sender has accountability for delivery of packet by recording the state information of receiving and analyzing the feedback from the receiver. If the group is initiated by receiver then it is called as receiver initiated multicast routing protocols. Here receiver holds the responsibility for identifying transmission error and loss of packets. A receiver comes to know about packet loss when it identifies the disorder in the identification number of packets it has received.

2.4.1. 3 Maintenance based multicast routing

There are two different fashionable ways in which maintenance of a multicast group is carried out. One is a soft state and the other is hard state. In the soft state mechanism control packets are flooded periodically to refresh the route which paves a way to high packet delivery ratio at the cost of more control overhead. If the routing changes, Control packet spontaneously records the necessary state along the new route. In hard state multicast routing protocols, protocol's state remains stable for a longer time. Control packets are transmitted only when a link failure, which leads to low control overhead at the cost of a lower packet delivery ratio (David & Marilia, 2012). Some multicast routing protocols act both as sender initiated and receiver initiated. Such protocols are called as a sender - source initiated protocols.

2.4.2 Application Dependent Multicast Routing Protocols:

It is already stated that multicast routing protocols for MANET follows the framework of fixed wired network. Some application exclusively created in MANET poses some extra problems in addition to the problems exist in fixed networks. Application dependent multicast routing protocols are again classified into energy efficient, reliable and QoS multicast routing protocols as described in the following section.

2.4.2.1 QoS based multicast routing

Most of the conventional multicast routing protocols are designed to focus on minimizing the congestion and average hops number for effective packet delivery (Mohammad et all, 2011). When QoS takes into account some protocols may be unrealistic or unusable because of the reasons like insufficient resource, unnecessary control overhead and insufficient knowledge about the entire network state. A very few protocols do not bother about QoS, For instance Location Guided Tree (LGT) and Core Assisted Mesh Protocol (CAMP). Usually QoS is measured in terms of bandwidth and delay. Giving an assurance for QoS in MANET is very difficult because wireless bandwidth is allocated not only for that node but also for adjacent nodes. Moreover, network topology often changes in wireless networks. The QoS multicast routing protocol for clustering mobile Ad-hoc network is one of the examples for a QoS routing protocol for MANET.

The classification chart has shown in the Figure 2.3 portraits the classification of QoS multicast routing protocols for MANET. The routing protocol and QoS provisioning strategy are in close interaction with each other for ensuring QoS guarantees in coupled QoS protocol. It fails if there is a change in the routing protocol. As far as decoupled protocol is concerned, it does not rely on any specific routing protocol to deliver QoS guarantee. In case of the independent QoS protocol, network layer does not need support from the MAC layer to ensure QoS provisioning whereas dependent QoS protocol requires support from the MAC layer.

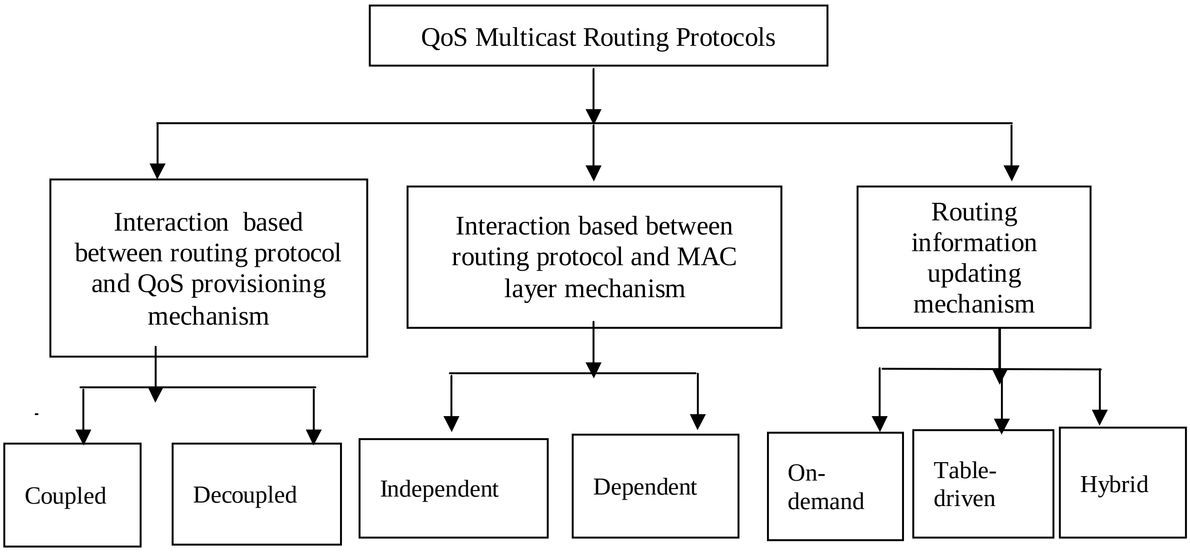

Figure 2.3 Classification of QoS routing protocols

QoS multicast routing protocols based on routing information updating are table driven, on-demand and hybrid. In table driven protocols all nodes in multicast group maintain a routing table which helps in forwarding data packets. Whereas on-demand QoS protocols contain no tables so source node has to explore the route when needed. The hybrid QoS protocols enjoy the features of both table driven and on-demand QoS multicast routing protocols

2.4.2.2 Energy efficient multicast routing

Any kind of electronic gadgets is given life by means of electrical energy. A few electronic devices are powered and run on batteries. The battery has certain limitation of the power supply. A node in MANET is one such electronic device which will stop functioning when its battery power gets exhausted. Then the node gets separated from the entire network. Therefore, energy constraints play an important role in designing energy efficient multicast routing protocols. The goals of these protocols are to increase the lifetime of nodes, which in turn increase the entire network. Jiageng et al (2005) suggested that energy efficient protocols work on two types of algorithms, namely augmentation and local search algorithms.

The Protocols that used augmentation algorithm builds a multicast tree by initiating from empty solution which is gradually increased until a guest network finds a path from the root to end node. Then the guest network is formed into multicast tree. It has various solution schemes such as an edge, a spider and a path. The goal of this protocol is to select a path which consumes less energy for delivering the messages. The local search algorithm makes a walk on a multicast tree that is given as an input and set forward to the new multicast tree. It deletes the edges of the tree which is likely to disconnect from the network. The rule to add a new multicast tree is to maintain the energy efficiency in delivering the packet. Cheng et al (2006) developed the Minimum Weight Incremental Arborescence (MWIA) and Su et al (2006) proposed the Power- Controlled Hybrid Multicast Routing protocol (PCHMR) which are some of the examples of protocols that focuses on energy efficiency.

The classification chart in the Figure 2.4 depicts the types of energy efficiency routing protocols. An active energy protocol aims to find a route with low energy consumption. Subsequently minimize the energy consumed by each packet. The goal of maximizing network lifetime protocol is to make a balance between nodes of the network and it is designed based on residual energy available in a battery. Passive energy saving protocol aims at turning off unnecessary radio links as much as possible in order to save the power in the battery. In topology control protocols the number of connectivity a node has is calculated by its transmission power. Control over the transmission power not only maintains the stable links, but also reduce the power consumption.

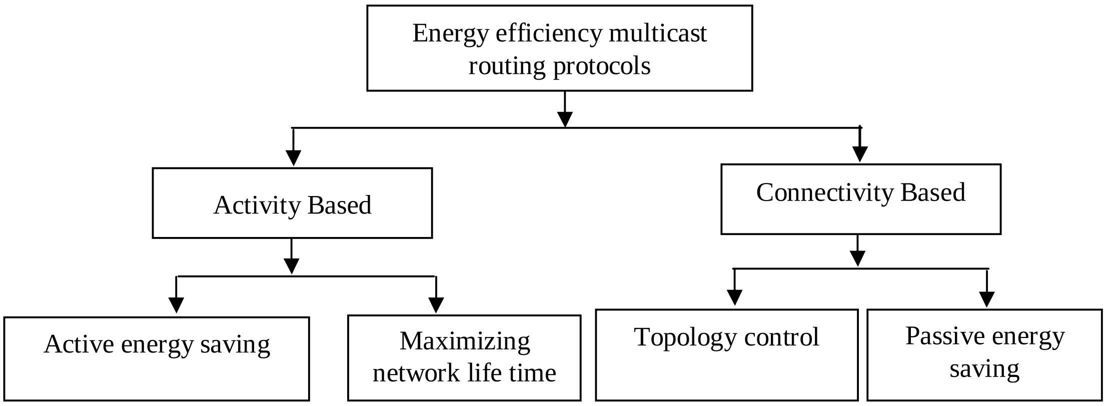

Figure 2.4 Classification of energy efficient multicast routing protocols

2.4.2.3 Reliable Multicast Routing

Every link of nodes is wireless and all the nodes are not stationary in ad-hoc network system. Hence those characteristics are the reasons for unreliable, increased packet loss and multicast inefficient. The transmission delays and packet losses due to dynamic link configuration in the multicast tree pose a threat to achieve an efficient packet delivery ratio. The research that focusing on reliability is predominant in designing a multicast routing for MANET. The design of reliable multicast routing has to address three important decisions, namely who detects errors in transmission, how error messages are given the signal and how missing packets are retransmitted. Protocols of these types have various design principles and operational capabilities in confronting the reliable issue.

They can be divided into four types as follows; sender initiated reliable multicast routing protocols where receivers send an acknowledgment (ACKs) for each packet that they have received. In receiver initiated reliable multicast routing, a receiver that does not receive the packet sends the negative acknowledgment (NACKs) to the sender. In ring based reliable protocols, receivers send the acknowledgment in round robin basis. Finally, in the tree based reliable routing, receivers are categorized into several subgroups to reduce the overhead for processing all control messages. Sun & Li (2006b) developed the Reliable Adaptive Multicast Protocol (RAMP) and Wang & Chang (2005) proposed the Reliable On-demand Routing protocol (RORP) which are a few examples of reliable multicast routing protocols.

2.5 SURVEY OF DISTINCTIVE MULTICAST ROUTING PROTOCOLS

To experience the feasibility of group communication in MANET system, many researchers have designed and implemented several multicast routing protocols for the ad hoc applications. In this section of thesis various principles, features and their relationship of multicast routing protocols are discussed. This survey includes multicast routing protocols that inspire the researcher and reflect the fundamental phenomenon of multicast routing protocols, and protocols that provide innovative technical idea and their practical use. Some of the protocols surveyed have been published in popular international conferences or journals.

2.5.1 Stability –based Multicast Routing Protocol

Hui et al (2014) developed the Stability- based Multicast Routing Protocol (SMR). This approach provided the link stability estimation model based on received signal strength. The SMR is developed with incorporation of MAODV routing protocol. The SMR model is facilitated by free space model. In addition to ground reflection, the direct ray between sender and receiver is considered to determine the received signal strength. The stability record is maintained to update the received signal strength information. This method aimed at identifying stable route and being adapt to dynamic topology.

2.5.2 Stability –considered Density-adaptive Routing Protocol in MANET

Weijie & Wooju (2013) proposed a Stability-considered Density-adaptive Routing protocol (SDR). Routing tactics are performed based on density of nodes in the deployment area. If the density is low, then routing tactics is termed as sparse mode, if high, then routing tactics is termed as dense mode. The SDR is an example of a distributed routing protocol that opts for the infrastructure of MANET. The decision on the forwarding node declaration is done autonomously so routing tactics is termed as routing mode self selection. It is aimed at increasing the efficiency of the routing process, reduce the control overhead and also provided that stable routing is determined by SDR.

2.5.3 Onto- Scalable Ad hoc networks: Deferred Routing

David & Marilia (2012) developed the onto scalable ad-hoc networks using deferred routing concept. This approach required a minor change in existing link state routing protocol the OLSR. Deferred routing is meant that the nodes which do not have the essential information to reach a destination is required to postpone the sending task by selecting appropriate gateway. It is aimed at using in large scale scenarios. It is more competent enough to support any typical link state routing protocols.

2.5.4 Expected Routing Overhead for Location Service

Richard & Eunyoung (2011) suggested a mechanism that provides a new framework to quantify the routing overhead caused by control messages used for exchanging location information. The assumptions made in this mechanism are that node has freedom to move independently and their transmission range is adjusted to withstand network connectivity. In addition to GPS, information theory has been employed to utter the locations of node and subsequently the expected overhead is analyzed for proactive and reactive geographic routing

2.5.5 Geographic Routing with Location Service

Erik & Simin (2011) proposed a geographical routing algorithm named Location Aware Routing for Delay-tolerant (LAROD) networks. This algorithm is enhanced with a Location service and location Dissemination Service (LoDiS). This algorithm mainly focuses on reducing the overhead. A beaconless strategy is used in LAROD to obtain low control overhead when a packet is forwarded. A local database of node location is maintained and updated by broadcast gossip technique. The combined feature of LAROD-LODiS aims at providing an effective packet delivery ratio and low control overhead in the intermittently connected MANET.

2.5.6 The Privacy-friendly Routing in Suspicious MANET

Karim & Gene (2011) designed anonymous MANET routing protocol named the Privacy-friendly Routing in Suspicious MANET (PRISM). The PRISM aims at offering security and privacy in a suspicious location based MANET. The PRISM is designed in such a way that intermediate nodes could not know about the current location of the destination or source. This protocol is designed based on the foundation provided by AODV and aims at preventing node tracking.

2.5.7 Integrated Unicast and Multicast Routing

Garcia & Rolando (2011) proposed the Protocol for Routing in Interest-defined Mesh Enclaves (PRIME) which provides a framework that can integrate multicast and unicast in MANET. The mesh structured established by PRIME can be activated and deactivated based on the interest of individual destination nodes and groups. The PRIME aims at offering a high degree of scalability, less communication overhead and lower delay. The PRIME addresses both unicast and multicast traffic on considering minimum hop routing.

2.5.8 Geocast for MANET

(Robert 2011) described a novel geocast heuristic approach called the Center Distance with Priority (CD-P) aiming at better reliability and scalability. The nodes in CD-P approach retransmit packets based on local decision rules. The node close to geocast region first retransmits the packets and listens to all other nodes and it will cancel the retransmission if any of the other nodes closer to geocast region starts retransmission. This heuristic approach becomes very much useful in a complex terrain.

2.5.9 Efficient Geographic Multicast Protocol

Xiaojing et all (2011) proposed a novel Efficient Geographic Multicast Protocol (EGMP) in which a virtual zone-based structure is used to implement scalable and efficient group management. A zone-based bidirectional tree is built for better membership management and multicast delivery. Zone structure, tree construction and multicast packet, forward is guided by the position information. The EGMP aims at offering reduced overhead, high packet delivery ratio and providing scalability in terms of group size and network size.

2.5.10 Tree-based QoS Multicast Routing Protocol

Mohammad et all (2011) investigated the problem of QoS routing in MANET. They proposed a model that explores for QoS path from a single source to a set of destinations. The environment is divided into equal size hexagonal cells and each cell has a leader and back leader nodes to update the network topology. This model aims at offering a feasible path to ensure the quality of service.

2.5.11 Agent-based Multicast Routing Scheme

Biradar & Manvi (2011) proposed an agent-based multicast routing scheme named Reliable Ring Multicast Routing Agency (RRMA) in which a backbone in the form of reliable ring is built and multicast routes are found using that ring. The authors used the convex hull algorithm to identify the outer boundary of the network. The reliable ring is created at an acceptable distance between the outer boundary and the center of the network. A set of mobile and static agents is employed to make a reliable ring and agents are used to overcome the link failure and node failure. The RRMA aims at improving the control overhead, packet delivery ratio and group reliability.

2.5.12 The Location Prediction Based Routing Protocol

Natarajan (2011) proposed the Location Prediction Based Routing protocol (LPBR) for mobile ad-hoc networks. This approach aimed at minimizing the route path discovery. The route path is discovered by broadcasting a Route Request packet (RREQ). When the route request packet is flooded, each node that forwards RREQ packets ensures that it has incorporated its Location Update Vector (LUV) in the RREQ packet. The

LUV provides the information about the node id, node's current position in the form of X, Y coordinates and the current speed and degree of movement with respect to X coordination. The destination node gathers the LUV information of all nodes with the help of RREQ packet and reply to the source by sending Route Reply packet (RREP) on considering minimum hop count between source and destination. Thus LPBR provided the features like minimizing simultaneous route discovery and reducing the hop count between source and destination.

2.5.13 The Robust Scalable Geographic Multicast Protocol

According to Xiaojing et al (2010) the Robust Scalable Geographic Multicast Protocol (RSGM) is a location aware multicast routing protocol. It follows effective group membership management using two- tier architecture. At the lower tier a zone construction is built based on position information and a leader is selected for that zone. The leader manages the group membership and gathers the position information of each member in the group. In the upper tier the group leader informs the membership about the source of multicast group using virtual reverse based tree structure. If group leader does not know the address or position of the source then it will get it from source home. With the help of member zones the source forwards the packet to zones that have group members along the virtual tree rooted at the source. Once the packet has been arrived at a member zone, then the group leader takes responsibility to forward the packet to all local group members along virtual tree rooted at the group leader.

2.5.14 Policy Based Clustering Multicast Routing Algorithm

Zhiguo & Deyu (2010) proposed a Policy Based Clustering Multicast routing protocol (PBC-MAODV) designed based on MAODV. The multicast routing tree is constructed using self-restraint flooding strategy. The priority strategy is determined based on the link alive time between two neighbor nodes and route alive time between the source and the destinations. This protocol aims at reducing control overhead and increasing the packet delivery ratio.

2.5.15 Stable Link Based Multicast Routing

Kamal & Lalit (2010) proposed the Stable Link Based Multicast Routing (SLBMR). The Proposed idea mainly focuses on two types of link failure. The one is due to mobility another is due to low battery power. The route is chosen through the node which has more connectivity to its neighbor nodes and which has required battery power. Transmission range, speed of mobility and direction of movement along with battery power are considered. The SLBMR aims at offering energy efficient multicast routing scheme.

2.5.16 Reliable Opportunistic Multicast

Yang et all (2010) designed a Reliable Opportunistic Multicast routing Protocol (ROMP) based on opportunistic routing, network coding and expected number of transmissions (ETX). The link quality is determined in terms of ETX. ROMP is a proactive multicast protocol in which a set of multiple next hops is defined to reach destination. The loss rate of links to neighbors is calculated with the help of the default multicast tree. The ROMP aims at providing the reliability and reduced overhead.

2.5.17 Link Stability based Multicast Routing scheme

Rajashekhar et al (2010) proposed the link stability based multicast routing scheme. This approach is developed based on multicast routing scheme. The multicast routing scheme in turn identifies the stable path from source to receiver. The multicast mesh is built by using the route request and route reply packets. Every node in this approach maintains a link stability database with an aid of multicast routing information. The link stability is calculated by using the parameters like receiving power and distance between neighboring nodes. This method is aimed at providing stable and reliable multicast routing protocol to offer efficient packet delivery ratio, minimum joining delay and diminished control overhead.

2.5.18 Mobility- based Multicast Routing algorithm- Learning Approach

Tokestani & Meybodil (2009) proposed distributed learning automata–based multicast routing algorithm named Mobility- based Multicast Routing algorithm- Learning Approach (MMR-LA). In this approach, each mobile node propagates its mobility information like speed and direction to its neighbourhood node whenever it encounters a change in mobility characteristics. Then each node estimates its relative mobility characteristics to form a virtual multicast backbone based on the latest information received. The host with the more stable routes is identified. This approach is aimed at decreasing the link failure between routs and hence the packet delivery ratio is increased. Yet it has to be improved for robustness and scalability.

2.5.19 The Optimized Polymorphic Hybrid Multicast Routing

Mnaouer et al (2007) analyzed that the Optimized Polymorphic Hybrid Multicast Routing Protocol (OPHMRP) is a proactive energy efficient polymorphic hybrid multicast routing protocol. It achieves merits from proactive behavior and experience controlled network traffic overhead of reactive behavior. This protocol is designed based on the principle of amicability polymorphic modes of operation. It is adaptable to change its operational behavior so that it can improve the performance metrics like strengthening lifetime of the battery, decreasing communication delay and increasing delivery ratio. OPHMR exhibits four different operation modes. Two power control thresholds are used for battery life time and one mobility control threshold that stands for connectivity and topology changes. Finally, the density control threshold is taken into account when the mobility speed increases.

2.5.20 The Scalable Positioned Based Multicast Routing

Transier et al (2004) proposed the Scalable Positioned Based Multicast routing (SPBM), which is also a location aware multicast routing protocol. It is aimed at improving the scalability of the protocol to considerable group size. The network environment is partitioned into a square tree with number of levels. The top level depicts the whole network and bottom level is built by basic squares. Each next level square is divided into another four smaller squares. The nodes in basic squares are within each other’s direct transmission range. A node in a basic square periodically floods its position and membership criteria to upper level square. Such a periodic broadcast causes unwanted control overhead when network size increases. If a new member wants to join the multicast group, it has to wait and joining delay increases.

2.5.21 The shares Tree Ad-hoc Multicast Protocol

Canourgues et al (2006) proposed the Shares Tree Ad-hoc Multicast Protocol (STAMP) multicast routing protocol which is one of the core rooted reactive multicast routing protocols, and works independently without an aid of any underlying unicast routing protocol. A source node of a multicast group in STAMP is not needed to join the multicast delivery structure in sending data packets to the group. Datagram packet is transmitted on the shortest path between the source and the core. Once a data packet arrives at a tree member, it gets forwarded on the tree. Ultimately a distributed mechanism is employed to select the core node among all receiver nodes of a particular multicast group. In STAMP core node is determined in advance. It incorporates the merits of both mesh and tree based protocols and offer high packet delivery ratio under dense traffic and high mobility.

2.5.22 The Bandwidth Optimized and Delay Sensitive protocol

According to Inn & Seah (2006) the Bandwidth Optimized and Delay Sensitive protocol (BODS) is a source rooted mesh based multicast routing protocol that operates in a distributed manner . A multicast delivery structure is established based on the nearest participant heuristic approach so that BODS offers effective bandwidth efficiency without forgoing delay performance. The performance of this design is clarified by incorporating BODS into ODMRP. The packet delivery ratio of BODS is almost similar to ODMRP or slightly better than that of it. BODS protocol is a more common protocol that can be incorporated with any other mesh based protocol.

2.5.23 The Multicast Power Greedy Clustering Protocol

Leu et al (2006) suggested that the Multicast Power Greedy Clustering Protocol (MPGC) is power aware on-demand mesh oriented multicast routing protocol. In the initialization phase of the protocol hierarchical cluster structures having greedy power control are established. Each node in this hierarchical cluster can amend its transmission power so that it is capable of managing individual geographical location. Here it is assumed that each node has various levels of power for transmission and one cluster head gets connected with other cluster head in order to provide a strong connection. The greedy heuristic clustering approach makes an attempt to divide the large scale ad-hoc network into number of cluster. At the same time it aims at power preservation.

2.5.24 The Power Aware Multicast Routing Protocol

Song et al (2006) investigated that the Power Aware Multicast Routing Protocol (PMRP) is a tree based mobility prediction energy efficient multicast routing protocol. The goal of this protocol is to choose a set of paths that last for a longer period of time and ensures the reliability of the routes in routing exploration. To achieve the above said aims, PREQ packet is sent to each node and let the nodes know about the amount of power needed to transmit the packet by means of power aware metric. If the node has sufficient residual energy to transmit the data packets, it is allowed to use the GPS to know about the location of mobile nodes. This information is used to calculate the link expiration time between any two connected nodes. When the route discovery is performed, each destination node chooses the routing path that has the lowest Link Expiration Time (LET) and then this lowest LET is considered as the Route Expiration Time (RET). After that the destination nodes gather several optimal routes and then the primary routing path is selected by choosing one of the optimal paths that has the longest RET. Then multicast tree is constructed between the source node and each destination node using these optimal routes.

2.5.25 The Code Cast Multicast Routing protocol

Park et al (2006) analysed that the Code Cast Multicast Routing protocol (CCMRP) is a network coding multicast routing protocol, which executes both packet loss recovery and offering optimal path diversity. This protocol is very much applicable to multimedia data delivered by a multicast routing service. Network coding is an applied randomly to rover the packet loss within a restricted local area and to achieve the optimal path diversity. CCMRP is designed based on the assumption that an equal size of frame is generated and the frame is observed by either port number and source address pair or distinctive identification number assigned to each frame globally. The merit of this CCMRP is effective packet delivery with minimum control overhead.

2.5.26 The Distributed QoS Multicast Routing Protocol

Sun & Li (2006a) proposed that the Distributed QoS Multicast Routing Protocol (DQMRP) is a shared tree based QoS multicast routing protocol. The source node builds a multicast tree iteratively. The source node uses an exclusive frame, called an explored frame. The purpose of the explored frame is to record the information about all the intermediated nodes that come across possible optimal paths from the source node. These intermediate nodes transfer the received explored frame to its entire neighbor node except the source node. The destination node selects one of the feasible paths that cost minimum and sends its resource information to source node by means of reply message and includes it into the multicast tree. The destination node maintains information about all other optimal path by holding explored frame. This process is carried out incrementally to build a multicast tree.

2.5.27 The Adaptive Core Based Multicast Protocol

Kaliaperumal (2005) developed the Adaptive Core Based Multicast Protocol (ACMP).This is an on-demand source rooted shared tree multicast routing protocol. The ACMP is capable of making the balance between routing overhead and packet transmission more effectively. All group members on demand are connected using a tree structure. A core node acting as a source helps the group member to join the multicast group. Core also takes responsibility to control traffic for group members joining the multicast group. The ACMP is able to identify the link failure during data forwarding in two different phases, namely the local route recovery and periodical multicast tree refreshing to maintain the most favourable multicast tree. It provides efficient bandwidth and effective power consumption.

2.5.28 The Mesh based Multicast Routing Protocol with Consolidated Query packets

Dhillon & Ngo (2005) examined that the Mesh based Multicast Routing Protocol with Consolidated Query packets (CQMP) uses a query packet consolidation to face the scalability problem. It is a reactive mesh based multicast routing protocol. If multiple sources exists core, node is selected to map several multicast addresses at a time. CQMP is implemented using underlying unicast protocol. CQMP is assumed as another version of a beaconing protocol and relies on associated routing protocol to face the link failure and network partitions.

2.5.29 The Mobile Agents Aided Multicast Routing Protocols

Shekhar et al (2005) explored that the Mobile Agents Aided Multicast Routing Protocol (MAMP) is a QoS based reactive hybrid multicast routing protocol in which intelligent mobile agent is used with any other on-demand multicast routing protocol like MAODV and ODMRP. Similarly MAMR is integrated with either ODMRP or MAODV in order to improve the route discovery. Here mobile agents are simple packets that roam over the network and provide topological information of nodes and other QoS metrics such as link delay, traffic overhead. This information is very much useful to determine the efficient route delivery if no route is available in the multicast table. Therefore, additional delay that might be required is reduced in discovering a new route to destination and also reduces the end-to end delay. Though this approach incurs additional cost for managing mobile agents, it offers very good packet delivery ratio and optimal end-to-end latency.

2.5.30 The Logical Hypercube Based Virtual Dynamic Backbone Protocol

Wang et al (2005) analysed that the Logical Hypercube Based Virtual Dynamic Backbone (HVDB) is very much helpful for large scale MANET. It is a proactive QoS aware hybrid multicast routing protocol. Route maintenance is held logically using symmetric and regularity properties of the hypercube. No leader is selected in the logical hypercube because almost all nodes play the same role as others except border cluster head and inner cluster head. The main advantage of this protocol is high fault tolerance and good load balancing

2.5.31 The Efficient Hybrid Multicast Routing Protocol

Biswas et al (2004) reported that the Efficient Hybrid Multicast Routing Protocol (EHMRP) is a hybrid multicast routing protocol, which is very much apt for the environment where mobility is high and scalability is predominant. It maintains separate path for forwarding data and to forward joint query. The EHMRP integrates low overhead clustering mechanism to categorise all nodes, whether they are core or normal categories. In the event of unavailability for multicast source route to destination nodes, joint query messages are propagated to all nodes.

Core nodes take responsibility to forward a data packet to the destination using the Differentiated Destination Multicast technique (DDM). The DDM is a stateless multicast routing protocol which is not required to maintain the multicast states in the nodes. In this approach each data packet header is added with the information about multicast tree. The EHMRP does not lend a hand to any underlying unicast routing protocol. The main mechanism of EHMRP are classification of nodes as core or normal, detaching data forwarding path from forwarding join query path, unique handling of received packets that come from DDM path and update of group membership.

2.5.32 The Robust Multicasting in Ad-Hoc Network Using Tree

Vaishampayan & Garcia (2004) presented that the Robust Multicasting in Ad-Hoc Network Using Tree (ROMANT) is a reactive tree based multicast routing protocol. It uses the existing control packet itself to overcome the problem due to link failure, whereas Mobile Ad-hoc On-demand Distance Vector (MAODV) uses the special control packet named group hello. It is very much helpful to fix the problems experienced by MAODV such as heavy control overhead, low packet delivery ratio due to high mobility. The ROMANT does not depict any new problems. The procedure for joining different partitions together is very simpler than that of MAODV. ROMANT does not depend on any underlying unicast protocol as well as eliminate the set back of MAODV. The ROMANT is better than ODMRP in offering packet delivery ratio.

2.5.33 The On-demand Multicast Routing Protocol

Gerla et al (1998) demonstrated that the On-demand Multicast Routing Protocol (ODMRP) is a mesh based multicast routing protocol working in two phases, namely mesh initialization phase and mesh maintenance phase. In mesh creation phase source in the multicast group floods the join request packet at regular interval; the receiver sends the join reply along the shortest path on receiving the join request control packets. The route is built between a source and receiver after source receives the join reply packet.

The nodes that receive a join request update the upstream node identification number and flood the packet again. Thus the mesh is formed by the set of forwarding nodes. In mesh maintenance phase, ODMRP uses soft state mechanism to maintain the mesh. To refresh the route between source and receiver, joint request is flooded periodically by the source. So ODMRP offers high robustness, but this is achieved at the expenses of huge control overhead. The same datagram is propagated through more than one path to destination therefore multicast efficiency is reduced.

The summary of the above narrated survey from section 2.5.1 to 2.5.33 about robustness and scalability is tabulated given below

Table 3.1 Summary of literature survey

Name of the Author	Protocol/ Mechanism	Contributions	Limitations
Hui et al (2014)	SMR	Offers link stability and incorporated with MAODV	Requires maintenance of a stability record
Weijie & Wooju (2013)	SDR	Routing is performed based on density of nodes and aims at increasing efficiency of routing process	During sparse mode, it is difficult to identify routing
David & Marilia (2012	OSADR	Deferred routing does not require extra information. It aims at using in large scale scenario.	It relies on OLSR
Erik & Simin (2011)	LAROD	It involves geographical routing algorithm and aiming at reducing overhead	A local database has to be maintained
Karim & Gene (2011)	PRISM	Aims at offering security and privacy	It has to rely on AODV
Garcia & Rolando (2011)	PRIME	Consider minimum hop routing and aims at offering less overhead	It offers less link stability
(Robert 2011	CD-P	Based on local decision rules and aims at better reliability and scalability	Mobility pattern has to be maintained
Xiaojing et al(2011)	EGMP	Aims at reducing overhead and high packet delivery ratio	Performance is confined to group size and network size
Mohammad et al (2011)	QoS routing	Explores QoS path from single source to set of destinations	Periodic update of network topology is required
Biradar & Manvi (2011)	RRMA	Reliable ring is built and convex hull algorithm is used to identify the boundary	An agent is required to build a reliable ring
Natarajan (2011)	LPBR	Aims at route path discovery and reducing the hop count, packet delivery ratio	It requires periodic broadcasting of route request packet

to Xiaojing et al (2010)	RSGM	Location aware multicast routing protocol in which group leader for a zone takes responsibility	It lacks robustness
Zhiguo & Deyu (2010)	PBC-MAODV	Constructed using self restraint flooding strategy and aims at reducing control overhead	Failure in identifying link alive time
Kamal & Lalit (2010)	SLBMR	Focuses on link failure and aims at offering energy efficient protocol	Topology has to be monitored periodically
Yang et al (2010)	ROMP	The link quality is determined in terms of ETX and aims at providing reliability and reduced control overhead	It offers low packet delivery ratio
Rajashekhar et al (2010)	Stability mechanism	Link stability is identified using receiving power and distance and aims at offering reliability and minimum overhead	It lacks scalability and database has to be maintained
Tokestani & Meybodil (2009)	MMR-LA	Mobility and speed information are considered and aims at minimizing link failure	Robustness and scalability are to be improved
Mnaouer et al (2007)	OPHMRP	Aims at strengthening battery life time	It lacks scalability and robustness
Transier et al (2004	SPBM	Location aware multicast routing and group management is done using zone based partitioned	It increases control overhead
Canourgues et al (2006)	STAMP	Incorporation of both mesh and tree based protocol and aims at high packet delivery ratio	It lacks scalability and robustness
Inn & Seah (2006)	BODS	It is based on heuristic approach and aims at bandwidth efficiency and throughput	It does not ensure link stability

Leu et al (2006)	MPGC	Aims at dividing large scale ad-hoc into number of cluster and providing power preservation	It lacks scalability and robustness
Song et al (2006)	PMRP	Aims at providing power preservation	It suffers from control overhead
Park et al (2006)	CCMRP	Aims at offering optimal path diversity and increasing packet delivery ratio	It does not offer scalability
Sun & Li (2006)	DQMRP	It introduces explored frame and aims at reducing average joining delay	It increases control overhead
Kaliaperumal (2005)	ACMP	It makes balance between routing overhead and packet transmission and aims at power consumption	It lacks scalability and increases control overhead
Dhillon & Ngo (2005)	CQMP	Aims at improving scalability	It has to rely on associated routing protocol
Shekhar et al (2005)	MAMP	Aims at improving route discovery	Construction cost is high and topological information is to be updated
Wang et al (2005)	HVDB	Designed for large scale MANET to offer robustness	It lacks scalability and high control overhead
Biswas et al (2004)	EHMRP	Suitable for high mobility environment	It lacks robustness
Vaishampayan & Garcia (2004)	ROMANT	Aims at overwhelming existing ODMRP	It lacks scalability
Gerla et al (1998)	ODMRP	It is a mesh based protocol aiming at identifying route through shortest path	It incurs huge control overhead.

2.6 INFERENCES FROM LITERATURE SURVEY

When a protocol is developed for MANET, it has to face various challenges. Most of the protocols designed for multicast routing in MANET mainly focus on either reactive or proactive architecture. The proactive routing protocols have to maintain a table and the table has to be updated whenever a change in network topology occurs. In proactive routing protocols all nodes have to monitor the network topology. In the reactive routing protocols the route discovery is initiated only when the source node desires it. The survey studied that the reactive protocols can offer a higher degree of scalability than the proactive protocols. After analyzing various surveys for multicast routing, it is known that a tree based multicast architecture does not offer the reliability and robustness because only one path between source and destination exists in a tree based architecture.

If the path is broken, the delivery of packet can’t be made to the destination through that path. In mesh based architecture there exist a number of paths. In spite of robustness in the mesh based architecture, the delay for packet delivery increases. It is inferred that the proactive routing protocols do not offer scalability and tree based architecture do not support robustness. It is learnt that the group management using control messages makes a great impact on control overhead of multicast routing.

2.7 RESEARCH GAP IN MULTICAST ROUTING PROTOCOLS

As far as multicast routing is considered the issues like group management, robustness and scalability are important. When a data packet is propagated on multicast routing in MANET, the packet is subject to various kinds of propagation loss .Subsequently the data packet sent by a group leader would be dropped in the mid of the transmission. The lost data packet is to be recovered and make it available to the group member which has not received the packet. The robustness is to be ensured whenever a packet loss occurs. The protocols having been designed so far have not addressed the robustness and recovery of lost packet using minimum control messages. The group leader of the multicast group is to be managed in an efficient manner so that it can withstand for a longer period of time to act as the group leader of the same multicast group. The group leader and group members are to be assisted by some alert messages.

No location aware protocols have supported the efficient group management .Hence the persistency of group leader has to be addressed and the group leader has to be preserved from random mobility. The protocol designed for multicast routing is capable of supporting the number of nodes so the scalability is to be maintained without increasing joining delay and without affecting the packet delivery ratio. The secured scalability is to be achieved. The information about the new group is to be made known to all other existing groups without delay. The protocols designed so far have not addressed the fast secured scalability.

2.8 PROPOSED MULTICAST ROUTING PROTOCOL

The thesis proposes a new multicast routing protocol for MANET named Mutual Sharing Range Detection Multicast Protocol (MSRDMP). This MSRDMP is proactive tree based multicast routing protocol. The MSRDMP provides various features to the application of MANET in different environments. The main aims of MSRDMP are to attain the effective group management, robustness and scalability on multicast routing in MANET. When these aims are attained by the MSRDMP, increased packet delivery ratio, reduced control overhead, optimized average path length and reduced joining delay are the objectives achieved through the proposed protocol MSRDMP. In group management group leader and members of the group have to be managed effectively.

The MSRDMP provides the persistence leader selection algorithm through which effective group management is achieved. The MSRDMP introduces the new interim CTS recovery mechanism to recover the lost packet and ensures the robustness and reliability. The secured scalable algorithm provided by the MSRDMP can allow the legitimate node to join the existing multicast group. The new group construction is easily facilitated by the appendix packet introduced in the proposed protocol MSRDMP.

2.9 SUMMARY

The brief introduction of the chapter is given at the beginning part. The routing protocols like unicast , multicast for MANETs are discussed and the difference between proactive and reactive routing protocol is explained . The characteristics of multicast routing are narrated in which evaluation principles and performance criteria of multicast routing are explained. The taxonomy of multicast routing is charted and discussed and the literature survey of various multicast routing protocols is analyzed. Finally it is found that most of the protocols devised for multicast routing do not offer the features like robustness, scalability and routing persistency. At the end of the chapter brief introduction about the proposed multicast routing is highlighted.