CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

An extensive literature review was carried out on streaming of multimedia data and other routing issues in MANETs. Many routing protocols are available in MANET, which are already discussed by many researchers. But the major concern is to select the existing one and enhance them suitably for the given problem. Based on this thought the literature work is done, which in turn helps to understand the needs, implementation views and analyze the limitations of existing protocols to enhance them.

2.2 REVIEWS ON ROUTING IN MANET

Routing in ad hoc networks needs new and specialized protocols. Since the application of traditional routing algorithms of wired networks like distance vector routing and link state routing to ad hoc networks suffer from additional routing overheads because of the dynamic nature of ad hoc networks. There are few works, which are available in the literature, that deal with routing in ad hoc networks in the early days of ad hoc networks (Gafni & Bertsekas 1981, Jaffe & Moss 1982, Garcia-Luna-Aceves 1989). The routing protocols of ad hoc networks that are discussed in the literature can be classified into four categories, namely, proactive (table driven), reactive (on demand), hybrid and secure routing protocols.
2.2.1 Table Driven Protocols

Proactive routing protocols maintain consistent and up to date routing information about all other nodes in each node of the network by maintaining one or more tables in each node. Table driven protocols periodically exchange these tables among the nodes of the network to reflect the changes taking place in the topology. Destination Sequence Distance Vector (DSDV) routing is an enhanced version of distributed Bellman-Ford algorithm (Perkins & Bhagwat 1994), in which route advertisements are initiated by a destination with a sequence number. The main advantage of this protocol lies with its ability to discover new routes periodically and hence is more suitable for capturing mobility of nodes in an ad hoc network. However, DSDV suffers from count-to-infinity problem, system wide broadcasts even for a small change in topology and slow convergence rate at higher mobility. The count-to-infinity problem and slow convergence of DSDV are addressed in Wireless Routing Protocol (WRP) by employing a unique method of maintaining information regarding the shortest information to every destination node and the penultimate hop node on the path of every destination node (Murthy & Garcia-Luna-Aceves 1996). Moreover, WRP uses a set of tables to maintain more accurate information. Maintenance of multiple tables requires more memory capacity and higher processing power at nodes. WRP also suffers from the scalability problem like DSDV. There are many other works on table driven routing (Basagni et al. 1999, Garcia-Luna-Aceves & Spohn 1999, Bopanna&Konduru2001, Samar & Haas 2002).

Optimized Link State Routing (OLSR) protocol is a proactive protocol where size of the control packets and the number of links that are used for forwarding are reduced (Clausen & Baccelli 2005, Mccabe et al. 2005). Topology Dissemination Based on Reverse-Path Forwarding (TBRPF) (Garcia-Luna-Aceves & Roy 2004) is a proactive, link-state routing protocol,
which provides hop-by-hop routing along shortest paths to each destination. Each node running TBRPF computes a source tree (providing paths to all reachable nodes) based on partial topology information stored in its topology table, using a modification of Dijkstra's algorithm. Garousi (2005) suggested a modified version of DSDV, which gives emphasis for mobility and communication patterns of the network to reduce the control overhead and speed up the route discovery process.

Comparing with the works available in the literature, the work discussed in the thesis differs in many aspects. First, in the proposed proactive algorithms, it is not necessary to maintain topological information of the network for route discovery and route maintenance by the nodes of the network. Second, in route discovery, the intelligent agents were used to carry out the routing updates to achieve increased node connectivity in the network. Third, in route maintenance, the 1-hop neighbors of active nodes are maintained as passive nodes. These passive nodes will become active whenever a node or link failure occurs and hence provides an automatic recovery from failures. As a result of all these features, the route discovery latency and routing overhead was reduced.

### 2.2.2 On Demand Protocols

The purpose of reactive routing protocols is to reduce the overheads incurred in proactive protocols by maintaining the routing information for only active routes on demand basis. Route discovery takes place through flooding of route request packets through the network. Dynamic Source Routing (DSR) is a reactive protocol where the source determines the whole path from the source to the destination and deposits the addresses of the intermediate nodes of the route in the packets (Johnson & Maltz 1996). The unique feature of DSR is, it is beacon-less which means that there are no hello-messages used between the nodes to notify their neighbors about their
presence. One of the most popular reactive ad hoc routing protocols is AODV (Perkins & Royer 1999, Chakeres & Belding Royer 2004). It uses the periodic beaconing and sequence numbering procedure of DSDV and the route discovery procedure of DSR. The main limitation of AODV is periodic beaconing and flooding of route requests that lead to additional bandwidth consumption whereas in DSR, the performance degrades rapidly with increasing mobility of nodes (Perkins et al. 2002).

There are many other reactive protocols that are present in the literature (Corson & Ephremides 1995, Toh 1997, Lee & Gerla 2000, Blazevic et al. 2005). Temporally Ordered Routing Algorithm (TORA) designed by Park & Coroson (1997) uses link reversal and route repair procedure and additionally creates Directed Acyclic Graphs (DAG) to reduce the far-reaching control messages to a set of neighboring nodes, where the topology change has occurred. However, TORA suffers from temporary oscillations and transient loops in the routing information. Another reactive routing algorithm called Location Aided Routing (LAR) reduces the routing overheads present in the traditional flooding schemes by using location information (Ko & Vaidya 1998). However, the LAR needs the availability of a Global Positioning System (GPS) to help each node to know its location. Flow Oriented Routing Protocol (FORP) is an on-demand protocol that attempts to reduce the effect of link failure due to mobility by predicting when a route is going to be broken (Su & Gerla 1999). Qi Xue & Aura Ganz (2003) described a QoS based version of AODV. Song et al. (2004) developed a novel extension of the AODV routing protocol, which applies the concept of load balancing to limit the amount of routing control packets. Many other works exist in the literature that discusses about the provision of alternate paths for AODV during the failure of routes (Chang Wu Yu et al. 2002, Weiss et al. 2003, Xuhui Hu et al. 2004, Tang & Zheng 2004). Valera et al. (2005) designed a new routing protocol named Caching and Multiple
Path (CHAMP) routing protocol. CHAMP uses cooperative packet caching and shortest multi-path routing to reduce packet loss due to frequent route failures.

Comparing with the existing reactive routing protocols, the reactive protocol proposed in the thesis is different in many ways. The existing reactive routing protocols use flooding of route requests throughout the network for route discovery and hence consume more power at the nodes and also network bandwidth. The proposed work minimizes bandwidth consumption by restricting the propagation of route request packets during route discovery. This is achieved through the source node by keeping track of the nodes that have already received route request packet which enables the intermediate nodes to forward route discovery packets individually and only to the required neighbor nodes instead of broadcasting it to all neighbors. Moreover, existing on-demand protocols do not repair a broken path locally. In such systems, line breaks are notified to the source and when the source node knows the path break, it reinitiates the path-finding process. A new reactive route maintenance scheme is presented which repairs the broken links locally by maintaining some additional information such as backup route for nodes on the path with minimum overhead.

2.2.3 Hybrid Protocols

Hybrid protocols combine the best features of both proactive and reactive protocols. The ZRP is a hybrid routing protocol (Haas 1997) in which a proactive routing scheme is followed for route discovery and route maintenance in a limited zone with r-hop neighborhood of every node, and that uses a reactive routing scheme for nodes beyond the zone. The Zone-based Hierarchical Link State routing (ZHLS) (Joa-Ng & Lu 1999) is another hybrid routing protocol in which the nodes make use of a GPS to form non-overlapping zones. ZHLS uses a hierarchical addressing scheme to
provide scalability in addition to the features of ZRP. Park & Voorst (2002) developed a Dynamic Hybrid Routing (DHR) protocol in ad hoc networks, which constructs paths only upon demand by taking attributes from both proactive and reactive algorithms. The goal of DHR is to re-use, whenever possible, portions of several existing paths when establishing a new path. The reusability is accomplished by using dynamic Proactive Zones (PZs). Wang & Olariu (2004) discussed a zone based routing protocol called Two-Zone Routing Protocol (TZRP), in which they divide the hops into two zones, namely, crisp zone and fuzzy zone to distinguish the neighbor nodes and farther nodes.

Most of the above schemes are based on defining a zone with respect to a node within a specified zone radius. However, one limitation of the existing schemes is that the selection of optimal zone radius is difficult to achieve and also varies with change in scenario. Some of the existing ant based algorithms depend on ants alone for route discovery and some of them combine ant-based discovery with reactive route discovery. In this research work, a hybrid intelligent ant based probabilistic routing algorithm that maintains multi-path routes is proposed in which we apply rules and learning techniques in route discovery so that it uses the past routes for effective route discovery. Moreover, this algorithm is self-built and self-configured which increases the survivability of communication in the network and hence suits the characteristics of MANET.

Moreover, the dynamic nature of wireless ad hoc networks poses a number of problems in designing proper routing protocols to forward data packets from source to destination (Royer & Toh 1999). Proactive protocols suffer from large consumption of bandwidth by exchange of routing information and reactive protocols suffer from excessive flooding and route discovery latency. Steve Appele by & Steward (1994) have discovered that
mobile agents similar to ants can be used to collect all topology related information from each node in the network and distribute them periodically as updates to other nodes. Mobile agents or ants are deployed to hop around the network in order to collect information from these nodes, meet other agents in their journey, interact with each other to collect updates of parts of the network where they have not visited or have visited a long time back, and handover these collected data sets to the newly visited nodes and agents. Chaudhary et al. (2001), Matruo & Mori (2001) and Huessein & Saadawi (2003) have discussed ant based routing algorithms for mobile ad hoc networks in which agents move from one node to another in the network, collect topology information, distribute them into the information cache of all other nodes and use this information to establish and maintain communication link between source-destination pairs.

Zeng Yuan-yuan & Yan-xiang (2005) have designed an ant-based algorithm named as Ant Routing Algorithm used Adaptive Improvement (ARAAI) strategy, which is based on swarm intelligence and especially on the ant colony based meta-heuristic. ARAAI is self-configured and self-built and hence matches the requirements of MANET. However the given strategy works incurs slightly higher route discovery latency and supports only limited QoS. Ant based probability routing algorithm for mobile ad hoc networks (ARAMA) suggested by Huessein et al. (2005) maintains multiple paths for a source-destination pair at each intermediate nodes to provide alternate paths in the case of route failure. However, in their work the size of the ants is large and hence the routing overhead is more.

Comparing with ant based routing techniques the intelligent agents based routing algorithm suggested in this work differs in many aspects. Moreover, the agents are able to move only through the cluster-heads and cluster-gateways. Therefore, it reduces the number of links traversed by the
ants. Another feature is that the ants move periodically in search of routes for different destinations. The ants work in coordination with the reactive protocol to enhance the connectivity between nodes and hence reduce the route discovery latency.

Tuteja et al. (2010) discussed about dynamic nature of MANETs without a physical infrastructure. In the MANET setup, each node is characterized as routers to discover the route in the network. And also has the ability to synchronize with other nodes. This work compares some recognized routing protocols such as, DSDV, AODV and DSR performance measures like delay between the nodes during packet, PDR (Packet Delivery Ratio), Routing overhead etc. the experiments are carried for different packet size to estimate the time interval in mobile nodes.

Qin & Liu (2009) provide a high reliable multipath source routing protocol to discover the route with high bandwidth. This protocol helps to find the many alternate paths to improve the QOS with proper load balancing mechanism. In addition, maintaining the route between source and destination is taken care without any network delay. The result also shows that packet delivery ratio is increased without any reduction in the span of the nodes in the network.

Sridhar et al. (2103) elaborated a new energy based AODV protocol which maintains the energy level of nodes after the packet transmission takes place at each node. The energy level is also depends on the packet size transmitted. It is also very helpful to know the node energy levels when the routing paths are selected for transmission of data. The threshold value is maintained to select the node for the routing path. By choosing the energy efficient nodes, failure in transmission due to node failure is reduced. Meanwhile, the packet delivery ratio is increased with high throughput.
Guo et al. (2011) developed a proactive routing protocol for MANET based on different objective which is suited for reduced end-to-end delay, increased network energy lifetime, and increased packet delivery ratio. This approach used three different metrics such as link stability, energy value of the node and delay at each node. This helps to predict the reason for failure at each node and improves the ability of system to identify the efficient path for packet transmission.

Hai-Yan An et al. (2005) designed the adaptive routing mechanism for MANET called Cluster-based Multipath Dynamic Source Routing (CMDSR). The hierarchical framework is defined here to carry out the process of route discovery and traffic diversion in multiple paths. The cluster formation also based on hierarchical form where one is node level and another one is server level. This kind of format helps to avoid the network flooding across the node. By this way, this approach does not need any separate mechanism for flooding control and minimizing the network overhead.

Sankaranarayanan (2010) presented the mechanism for detecting the congestion over the wireless ad hoc network to avoid the unwanted packet loss and delay in packet delivery. The existing AODV protocol is incorporated with early detection algorithm for congestion and called as Early Detection AODV protocol (EDAODV). This method identify the node which is not congested and also it may be the predecessor or successor of the congested node from the identified node, the path maybe constructed or re-constructed without any probability for congestion.

Yang et al. (2012) discussed about network coding based AODV protocol to support multipath routing. This work mainly concentrates on bandwidth of data transmission. It also provides better load balancing than existing system when compared based on experimental results.
Huiyao et al. (2004) identified the new method called Cluster Based Multipath Routing Protocol (CBMRP). It is mainly used to avoid congestion with bandwidth optimization to increase the channel sharing rate. This clustered approach done in a way of hierarchical structure to reduce the rating overhead between the networks. Experiments are carried out using this protocol to show that this method balancing the network load properly and increases the throughput with high stability nature for the network.

Rong et al. (2005) provides a view about node movement in MANET and gives an idea to grouping the nodes for routing. This work comes with new routing algorithm called Mobility Prediction Aided Multicast Routing. This routing methodology initially constructs a link between the nodes with hop-count and suggests a procedure for maintaining that link. The main advantage of this work is having the capability of handling the group of nodes dynamically.

Sharma et al. (2014) discussed about the multipath routing technologies for MANET with efficient load balancing. This work not only concentrates on shortest path between source and destination. It also maintains the energy level of each node that is needed for each transmission is taken into account for constructing the path with the nodes. This method also records the number of transmission takes place at each node. By this approach nodes with less energy are not taken for consideration. This energy based multipath routing protocol considers both the energy level of the node, shortest path and network cost. This approach also helps to maintain the lifetime of the paths.

Roy & Roy (2017) recently designed the dynamic topology to enhance the efficient routing in infrastructure less environment. In general, the dynamic movement of nodes and the mobility nature of this network are the main causes for routing overhead, and packet drops. The author describes
about multipath routing strategy, which selects multiple routes that are stable. The stable routes maintains in the routing table helps to reduce the energy consumption. This kind of data transmission depends on residual energy and Link Expiration Time (LET). By this multipath routing strategy, the reliability, load balancing and aggregation of bandwidth can be attained which increases the life time of the available networks.

Moshin et al. (2017) discussed about the dynamic topology of the MANET and its challenges in routing mechanism. The network needs the resources to be shared among the nodes to fulfill their requirements by enhancing the routing path in dynamic topology. The two protocols namely Hybrid Geo-cast Routing (HGR) and Signal Strength and Congestion Avoidance protocol (SSCA) is illustrated by the researchers to provide the reliable high quality links. The geographical information utilized by the adaptive approach helps to reduce the search area when the process of route discovery carried out. The SSCA mechanism helps to detect high quality path which is highly reliable and reduce the packet drop.

Chao et al. (2016) provides the study about constructing an efficient routing protocol in MANET with obstacles. It is assumed that the wireless nodes are equipped with a Global Position System (GPS) chip. We take advantage of the location information by GPS to propose a novel greedy propagation territory-based routing mechanism to establish the routing path between a source and destination. It defines a propagation territory to make a locally optimal decision for each forwarding node. The forwarding nodes, including a source and relay nodes, select one node in their propagation territories closest to destination as a next hop relay node to forward the packets until the destination is reached. Moreover, the signal interferences of nodes by obstacles are considered, while a source and relay nodes move close to obstacles. If the radio signal of a node is disturbed by an obstacle, the
neighboring node with the lowest signal interference in its propagation territory is substituted as a next hop relay node. In addition, it is shown that the proposed routing mechanism demonstrates a tradeoff improvement than those of the other on demand routing schemes in terms of the computational complexity and communication overheads.

Hussain (2016) discussed about routing mechanisms for packet delivery with high transmission capacity. In general, heterogeneous networks provide the path for sharing different resources among different routes. The route discovery includes mathematical expressions and conditions for route discovery with minimum time delay.

Ahmad et al. (2016) provides the importance of routing in MANET for multimedia data transmission. A Priority Based Mapping Method is explained which provides priority in the order of I (intra coded), P (predictive coded) and B (bidirectional predictive coded) frame packets. In addition, author tries to handle the expiry time of the packets as well as damaged acknowledgement of the packets/frames.

Ali (2017) concentrates on exchanging the multimedia content through MANET nodes in a reliable and scalable manner. As on MANETs are used only for vocal communication and text message sending purpose. Due to the wide usage of multimedia content like images, videos and audio files is a need to upgrade the MANETs for multimedia support. To achieve this, a hybrid routing protocol for multimedia data exchange is introduced, it is named as “Scalable and Multimedia compatible Dynamic Routing Protocol (SMDR) for MANETS”. Findings: After implementation of the proposed protocol the several things from results are obtained. It conducted the experiments with SMDR protocol and compared the results with popular ad-hoc protocols like AODV and OLSR. This protocol resolves the issues of multimedia content exchange over MANET nodes under various
circumstances. In perspective of speed, scalability and efficiency SMDR protocol recorded the best results over AODV and OLSR. From the experimental analysis and result is noticed that, the protocol is very suitable for mobile ad-hoc networks to transfer multimedia content.

Application/Improvements: In future, we are trying to extend this paper to elaborate this protocol to support multimedia content in a distinct way at each multimedia type level. Their future work process increases the scalability in multimedia transfer content and also improves the accuracy in a reliable manner.

Soni & Shah (2017) explained the communication in MANETs. Considering the developing requirements for multimedia and real-time traffic applications in real world, QoS support is essential in MANETs. But most of the characteristics of MANETs make QoS support a difficult problem. It is challenging to support QoS routing in MANET due to dynamic behavior and mobility of the hosts. The Optimized Link State Routing (OLSR) protocol can be efficiently used in MANETs to provide QoS routing because of its dynamic MPR (Multi Point Relay) selection criteria and proactive nature. In this paper, a design of QoS routing framework integrated with OLSR protocol is proposed and also analyzed using network simulator. Proposed QoS framework combines a bandwidth estimation algorithm with explicit resource reservation, QoS routing and Connection Admission Control (CAC). OLSR protocol is extended for QoS framework to solve performance issues related to node mobility using cross layer approach.

2.3 REVIEWS ON CLUSTER BASED ROUTING IN MANET

Cluster based routing protocols use specific clustering algorithms for cluster-head election. In ad hoc networks, mobile nodes are grouped into clusters and cluster-heads take the responsibility for membership management and routing functions. There are few works in the literature that deal with
cluster based routing protocols. The Cluster-head Gateway Switch Routing (CGSR) is a hierarchical routing protocol (Chiang et al. 1997) that uses a cluster structure for routing. In CGSR, mobile nodes are aggregated into clusters and a cluster-head is elected for each cluster in which gateway nodes are responsible for communication between two or more cluster-heads. Each node maintains a cluster member table that maps the nodes to their respective cluster-heads in addition to the routing table. All nodes broadcast their cluster member table periodically. Upon receiving broadcasts from other nodes, a node uses the Destination Sequence Distance Vector (DSDV) algorithm to update its cluster member table. In the Cluster Based Routing Protocol (CBRP) (Jiang et al. 1998), nodes are divided into clusters and the clustering algorithm is applied when a node joins the network to form the new cluster. In this protocol, a node starts with “undecided” state and initiates join operation by setting a timer and broadcast a “Hello” message. If the node gets a triggered “Hello” message from the cluster-head within the stipulated period, it changes its state to “member”. If it does not receive a message from a cluster-head before the local timer generates a timeout, it makes itself a cluster-head. Otherwise, the node remains in “undecided” mode and repeats the joining operation later.

The Hierarchical State Routing (HSR) (Iwata et al. 1999) is a multi-level cluster-based hierarchical routing protocol. At level 0, HSR functions very similar to that of CGSR in terms of cluster-head election and affiliation. Nodes in upper level hierarchical clusters flood the network topology information they have obtained to the nodes in the lower level clusters. In core-node based routing protocols for mobile ad hoc networks, critical nodes are dynamically selected to compose a "backbone" for the network. The “backbone” nodes carry out special functions, such as routing paths construction and control/data packets propagation. Access Based Clustering Protocol (ABCP) developed by Hou & Tsai (2001) is a simple
broadcast request-response with First-Come-First-Serve (FCFS) selection that is coupled with a probabilistic contention resolution scheme. The ABCP allows the network topology to change even when the clustering formation is in progress.

Since the devices of wireless sensor networks are power-limited in nature, conventional clustering approach poses many problems in wireless sensor networks. The major challenge is with cluster-heads, which are communication centers by default, tend to be heavily utilized and thus drained of their battery power rapidly. Liu & Lin (2005) suggested a re-clustering strategy and a redirection scheme in order to address the power-conserving issues in such networks.

Most of the existing cluster based protocols follow a simple grouping mechanism to form the clusters and follow table-driven routing mechanism. Even though some of these protocols perform well in certain scenarios, they incur heavy clustering overhead in large and dynamic mobile ad hoc networks. These protocols consume large amount of bandwidth because of the periodic exchange of routing tables and they suffer from the depletion of power in the cluster-heads. A new and sophisticated clustering algorithm is discussed in this research work avoids the ripple effects of re-clustering and the routes are discovered only on demand basis. This combination of optimized clustering algorithm and power aware reactive routing protocol reduces both routing overhead and clustering overhead considerably and the nodes spend their energy economically.

2.4 REVIEWS ON FAULT TOLERANT ROUTING IN MANET

Ramana & Krishna (2016) discussed about connectivity issues between end to end points in MANET for providing connectivity with fault tolerant. The author implements cook-ahead approach to overcome the
disadvantages in traditional routing process of MANET. It helps to maintain the uniform traffic which increases the node lifetime and reduced energy consumption. The time consumed also reduced for the cook-ahead approach. It maintains buffers for receiving packets that can be read.

Younis & Fahmy (2004) comes with the approach in distributed clustering ad hoc networks. The novel Hybrid Energy Efficient Distributed (HEED) clustering technique is used to maintain the availability of nodes with less power consumption. Their protocol mainly focused on cluster head selection based in the node proximity and its residual energy. And also, node density provides appropriate bounds between intra clusters and inters clusters with guaranteed corrections in clustered network.

Kiran et al. (2014) discussed the challenges in multimedia connectivity. It mainly focuses on fault tolerance by BeeHive routing approach. It also handles the random fluctuations in radio operation through hardware. This system is designed using Wi-Fi radios which work in multi hop network by partitioning the data before it is transferred. The experiments carried out and examined by creating faults randomly and applying some faults in network nodes. And also examines, that the throughput is not affected by the random faults.

Diaz et al. (2014) used a cluster based framework for optimizing the multimedia transmissions over wireless network. In general multimedia traffic is happened in the wireless networks due to the congestion among transmission nodes. In addition thus framework is designed to focus on decreasing QoS parameters like jitter, latency and packet loss. In addition this framework helps to maintain the load balancing and to recover the data loss by any node failure. To maintain the jitter and latency as low, the convergence time is reduced and maintained at the minimum load.
Tabatabaei & Hosseini (2016) provides a mechanism for handling the dynamically changing network through a fuzzy based approach. A fuzzy logic based on-demand routing protocol is used to maintain a on-demand routing with less energy consumption and increased speed of mobile nodes in order to create the route dynamically. It uses the AODV protocol with the fuzzy based approach to provide highly fault tolerant system.

Jaggi & Singh (2015) structured the fragile nature of MANET and the computing potential of the available network to enhance the fault tolerant environment. The check pointing is used to recover the failed transaction of rollback approach. The resilient feature of the protocol makes the dynamic nature of MANET with more reliable structure.

Lee et al. (2015) described the strategy for recovering the failure nodes by establishing bi-connected inter-partition topology. The author followed the heuristics approach for identifying relay node.

Tavakoli et al. (2015) suggested a fault tolerant algorithm for MANETs by assigning backup node(s) to each node tries to increase in fault-tolerance. For this reason, the proposed algorithm chooses the backup nodes from among those nodes having the same movement route. The nodes movement route can be determined or predicted through the backup nodes table. Choosing backup nodes is done based on the time of nodes adjacency. Experimental results taken from NS-2 simulator indicated that in comparison to other algorithms, the proposed algorithm increases by 1) the package delivery rate in relation to the percentage of fault, and 2) the package delivery rate in relation to various mobile nodes` pause time.

Jeong et al. (2015) explained an approach for handling faults in communication while multiple UAVs for cooperation and coordination. They have also described a fault tolerance scheme for the procedure. Although, in
this scheme the criteria for electing a new cluster header is based on the
distance and resource level, it is expected that other factors such as UAV
function, and memory capacity can also be considered and applied in this
procedure. Furthermore, in heterogeneous UAV systems, each UAV's
specialties will be other parameters to be considered in this approach.

Kantveer et al. (2017) the location of the nodules in MANETs
alters ultimately. Moreover, a nodule gathering appropriately at solitary spot
in moment can turn into defective shortly. Consequently, a fault-tolerant
direction-finding procedure is required on behalf of relocating statistics by
unambiguous data liberation velocity. Here projected resolution, Learning
Automata (LA) proposes a liability-liberal direction-finding procedure. LA
has been conventionally used to characterize organic knowledge structures.
The hypothesis of LA may be useful within troubles intending on verdict the
most favorable stroke, pleasing disorganized surroundings into description.
The knowledge sequence engrosses two constituents, the arbitrary
surroundings and a knowledge machine. The succession of knowledge is
achieved via cooperating among RS, as well as calculating its responses to
decide the finest (contiguous to most favorable) stroke.

Manohari et al. (2017) addressed the main issues with MANET is
Topology control arising due to its dynamic nature. Efficient control of
topology in MANET is possible only when mobility prediction is done to
avoid any kind of interruption in the communication. In this work, neural
network based mobility prediction model for topology control is proposed. In
this prediction model a highly scalable and accurate multi-layer architecture is
exploited to perform N-step prediction to forecast the future location of the
mobile nodes. The optimal path is then selected based on the minimum
interference, transmission power values of nodes and the path availability
using Ant Colony Optimization (ACO) technique. Clinical care data is
collected during the course of ongoing patient care. The proposed method provides uninterrupted communication for transferring clinical care data like details about rehabilitation hospitals for patients. The simulation results obtained prove that the above discussed technique is successful in reducing the packet drop, transmission delay and improves the packet delivery ratio as well as residual energy.

Deniz et al. (2016) introduces an adaptive, energy-aware and distributed fault-tolerant topology-control algorithm, namely the Adaptive Disjoint Path Vector (ADPV) algorithm, for heterogeneous wireless sensor networks. In this heterogeneous model, they have resource-rich super nodes as well as ordinary sensor nodes that are supposed to be connected to the super nodes. Unlike the static alternative Disjoint Path Vector (DPV) algorithm, the focus of ADPV is to secure super node connectivity in the presence of node failures, and ADPV achieves this goal by dynamically adjusting the sensor nodes’ transmission powers. The ADPV algorithm involves two phases: a single initialization phase, which occurs at the beginning, and restoration phases, which are invoked each time the network’s super node connectivity is broken. Restoration phases utilize alternative routes that are computed at the initialization phase by the help of a novel optimization based on the well-known set-packing problem. Through extensive simulations, they demonstrated that ADPV is superior in preserving super node connectivity. This system also increases the lifetime of the nodes individually.

2.5 REVIEWS ON ENERGY AWARE ROUTING IN MANET

Apart from various fault tolerant mechanism, the routing also needs energy aware approaches for efficient routing. This section discusses some of the works related with energy aware routing in MANET.
Das & Tripathi (2016) describe about energy efficient route for MANET and mobile nodes to be fitted with limited capacity of batteries. The author comes with the Intelligent Energy-aware Efficient Routing protocol for MANET. The protocol used the entropy based evaluation strategy to examine the efficient route. It also reduces the uncertainty of the node and offers energy efficient route.

Sarkar & Datta (2017) provide an energy aware routing protocol with multiple routing metrics. The protocol consists of three phases namely route discovery, route maintenance and trust module. The route discovery phase constructs the possible routes from source to destination by considering the node mobility data forwarding strength and energy level of the node. Based on this three metrics, the initial trust level of the node is evaluated. Route maintenance phase, protocol maintains the details of neighboring nodes and repairs the route failure happens by reconstructing the alternate route. Trust evaluation phase evaluates the trust of the node and maintains the reliable path between the source and destination.

Khan (2017) identifies the faults in MANETs and provides the frequent battery power with intermediate power supplies. In wireless networks connection failure occurs mainly due to power failure like draining battery power. So the author motivates with energy full protocol called Route Constancy Energy Aware routing which helps to improve the packet delivery and reduced network overhead.

Bheemalingaiah (2017) considers only mobile nodes that use wireless transmission and can be set anywhere and anytime because they eliminate complexity of infrastructure and central admission. They are essentially suitable when infrastructure is not present or difficult or costly to setup or when network setup is to be done quickly within a short period. They are very attractive for tactical communication in the military, rescue missions,
emergency situations and mobile communications. The routing is the major issue in the field of MANET due to the mobility nature and lack of infrastructure of the network. The different routing protocols have been proposed to address the routing issue.

Kaur et al. (2017) maintains the links in a continuously changing topology is a challenge especially for longer duration of time and in such scenarios the reliability of the links becomes the prime issue. Further, the reliability must be maintained in an energy efficient way as the MANETs have energy constraints. The existing routing protocols provide the shortest path from source to destination node in terms of hop count. These do not consider the energy efficient routes neither they consider the quality of the links while deciding the route between source and destination node. They presented an energy efficient version of RA-AODV named as ERA-AODV which measures reliability in terms of end to end delay, bandwidth and mobility of the intermediate nodes. Since the prime factor which determines the consumption of energy of the node is the distance of communication between them, the above discussed scheme takes into account adjustment of the transmission range of the mobile nodes according to residual energy; to provide improved energy efficiency. The second approach used in ERA-AODV is the use of location aided routing which reduces the number of nodes transmitting the route request packet in route discovery phase thus reducing the energy consumption.

Rashid et al. (2017) discussed about node responsibility for relaying data to neighboring nodes for ensuring communication between distant nodes. This information dissemination mechanism pattern consumes extra node energy thus making energy a critical parameter for ensuring increased network lifetime. They presented a new energy and mobility aware routing protocol referred to as Mobility and Energy Aware AODV
(MEAODV) protocol. The above discussed protocol has shown through simulations to achieve 4-5% increase in Packet Delivery Ratio, 20-24% reduction in Convergence time and 10 to 15% increase in Network Lifetime when compared to most promising stability based variants of AODV, Personalized AODV (RAODV) and Multicast AODV (MAODV-X).

Shaji et al. (2016) suggested position based protocols for ad hoc networks which provide better advantages as compared to topological protocols by utilization of location information. Location-Aided Routing (LAR) is one of the position-based routing protocols extensively studied. But in the case of LAR, not much work has been done utilizing energy based metrics as compared to its reactive counterparts AODV and DSR. The suggested protocol combines minimum energy metric along with multipath extensions to LAR and analyzed the impact of varying no. of nodes, speed and pause time on the suggested method and LAR.

Kulothungan et al (2011) provided the cluster based approach to grant the secured routing process without fault tolerant. And also, the energy consumption is less because of using cluster head to avoid rerouting through all nodes to rediscover the path if fault occurs.

Selvakumar et al (2017) depicted an energy aware routing mechanism for WSN by applying intelligent fuzzy rules in a secured way. The energy value calculated for each and every node after every transmission and updated in routing table to avoid fault occurrence. Another work of Selvakumar et al (2016) provides the secure energy aware approach for WSN suing clustering process.

Selvi et al (2016) discussed about the temporal approach for routing mechanism for WSN. The energy of nodes are updated in specific intervals to
avoid unwanted frequent updations of nodes energy level. This gradually reduces the energy consumption of inactive nodes.

Muthurajkumar et al (2017) provided the routing algorithm for energy efficient routing for MANET. It also make routing mechanism to be secure but it makes the system to more complex while new nodes are participating in routing.

2.6 REVIEWS ON SECURE ROUTING IN MANET

Another major concern in MANET is about trust based secure routing. Zapata (2002) gives detailed study about secured data transmissions in MANET. The main concern in secure network transmissions is to provide feasible approach for the trust network. The versions of AODV are renewed based on the requirements to avoid the possible attacks. And also, the additional requirements need some extra power requirements but that could be overcome by proper route discovery mechanism. In route discovery, the packets are forwarded only after the secure route discovery.

Jain et al. (2016) calculated the trust values locally of each node and accumulate the overall trust value of all routes between source and destination. RSA algorithm is used to transfer the file securely between source and destination. Signal stability routing is incorporated with AODV to provide congestion free routing to selected node.

Singh et al. (2011) provided the secure networks which does not have any centralized controls. Time based event ordering is used to generate the time interval between sending and receiving node. The time gaps between the nodes are maintained in the routing table for the nodes. When the node receives the packet from the sender, it also estimates the time taken for the packet from the source to destination. If the accumulated time exceeds the
estimated time, then the alert is issued at the receiver to intimate that there is an attack takes place in the received packet. Mostly, man in the middle attack and eaves dropping attacks are detected by this approach. Each node is checked before sending the data whether that node is authenticated or malicious node.

Sun et al. (2008) discussed about establishing trust among distributed network. In many security schemes, trust establishment itself creates vulnerability to attacks. In addition, defense mechanisms also established to detect the different attacks. The trust evaluation mechanisms are incorporated with different routing protocols and demonstrations are carried out to provide the comparison between the different routing protocols.

Li et al. (2008) described the framework for trust management to create the cooperation between trusted nodes. The trusted nodes form the robust framework which is attack resistant. The framework is explained in theoretical way and implementation view is still a question to overcome the vulnerabilities.

Velloso et al. (2010) presented the recommendation exchange protocol to provide trusted relationships between the nodes. The trust is calculated based on the information of nodes received from the neighbor nodes. The neighbor nodes exchange the nearest node information for trust calculation based on the previous experiences with them. The local trust calculation is passed over the network, which avoids the need of global trust value. The neighbor nodes are used to send the packets based on the trust values.

Cho (2012) developed a trust management protocol for group communication between mobile nodes. This protocol does not consider only the local trust value. It mainly requires the global trust value of the node to
provide collaborative framework. The chains between the nodes are built to show the trust level of the team or the trust level between the communicating nodes.

Wei et al. (2014) used the artificial intelligence technique to build the trust management scheme. The model used two types of trust values, one is direct and another one is indirect observation the direct trust value on. Bayesian inference is used to derive the direct value of node based on the dependency, on which the probability of the node is trusted. For indirect trust value, the information received from the neighbor node is taken for consideration and apply it for Dempster-Shafer theory. Both the method derived the trusted path based on uncertain reasoning.

Wang et al. (2016) modeled the context-aware trust management model which is applicable for all kind of networks such as peer to peer ad hoc and internet of things. Logistic regression is used to study the behavior pattern of the service provider trust. The accuracy of the study is evaluated to dissolve dishonest recommendations and also to avoid collision attacks.

Cho (2016) provided the key management scenefer secure transmission to MANET. Distributed trust based public key management is used to improve the security against data mitigation attacks. Every node has their trust values and that is used by other node to evaluate the trust of that node.

Jhaveri& Patel (2017) addressed the issue with a trust-model integrated with an attack pattern discovery technique. Extended from the Ad-hoc On-demand Distance Vector (AODV) routing protocol, a trust-based scheme founded on nodes' historical behaviors which adopts a pattern discovery mechanism in order to detect suspicious activities from the malevolent nodes before they start dropping data packets. Also describes the
detailed mode of operations of three distinct adversary models launching various kinds of packet forwarding misbehavior. Theoretical analysis and experimental results proved the integration of a pattern discovery method with a trust-based model provides earlier detection of adversaries which follow specific attack patterns and weakens their damaging effects on the network in comparison to a solitary trust-based model.

Vijayan & Jeyanthi (2017) provided a Context residual Energy-Based Trust Management (CEBTM) in mobile ad hoc networks by sharing the context data onto the other nodes in the network would give a better solution to this problem. They considered much context data like residual energy and packet drop strategy of the nodes are considered. An agent helps in retrieving the two context data from the neighbor nodes. Using this datum, the weight and reputation-based trust in each node with respect to the context data are found and is then fed into the fuzzy filter for analysis. This feature would help to understand whether the computed trust value is trustworthy or not. If not, a negative alarm is generated and sent to the other nodes for revocation.

Ganapathy et al (2012) discussed about intrusion detection system for wireless networks. The intelligent agents are applied to the nodes with reduced feature set to classify the intrusion nodes using SVM classifier.

Sivatha sindhu et al (2012) depicted the decision tree based classifier for intrusion detection. Another work carried out by Prema Rajeswari et al (2008) used the Ant Colony clustering approach for intrusion detection. But the feature selection is not carried out before classify will make the system to classify intrusion with more false positives.

Logambigai R & Kannan A (2016) described the fuzzy logic based clustering approach for WSN with unequal clustering approach. The energy
level of the node is maintained higher than any other approach by unequal clustering. It also provides shortest path between source and destination in an efficient way because of unequal clustering.

Jaisankar et al (2012) illustrated the intrusion detection system by using C4.5 to classify the given data set. It also used intelligent agents with rough set approach to get the accurate classification.

2.7 REVIEWS ON DELAY TOLERANT ROUTING IN MANET

D’Souza & Johny Jose (2010) have made an in depth study of the various routing protocols for Delay Tolerant Networks and classified them. It is not possible to classify each of the schemes into exactly one of the many classes. Most approaches are hybrid in nature and may fall into more than one category. The various schemes are classified based on the type of knowledge used by the routing protocol and also tried to follow the evolution of the various protocols, from one approach to another. A pure epidemic routing protocol does not require any knowledge about the network. However, in order to conserve resources, the flooding had to be controlled. For this, knowledge of factors like history of encounter, mobility pattern etc are be used.

Kretschmer (2009) presented DT-DYMO a combination of ad hoc routing based on the established Dynamic MANET On-demand Routing protocol and mechanisms for network storage and delivery likelihood prediction. DT-DYMO uses a route discovery mechanism in order to find the destination or nodes that are likely to be able to deliver the message in the future. The simulation results for wireless network scenarios with high mobility and temporary network disconnection. The result shows the significant increase the delivery rate in mobile scenarios and thus can overcome the limitations of traditional ad hoc routing. On the other hand,
DT-DYMO provides faster delivery than opportunistic message passing schemes that rely only on delivery likelihood estimation.

Sun et al. (2011) introduced features of delay tolerant network. First they have introduced the basic ideas about the origin and basic characteristics of DTN. Then, they discussed the DTN system structure, several typical network protocols and some key issues such as reliability transmission, congestion control, and security in DTN in details. Finally, they presented some application domains of DTN. Note that the DTN architecture is a fundamental change not just supplement to Internet and it employs a series of different design concepts. For example, the message instead of the packet, secure and reliable hop-by-hop communication instead of the end-to-end communications, the name-based routing instead of the routing based on address, and local connection instead of global connection. DTN can be easily compatible with existing TCP/IP protocols. There are many potential DTN applications such as Mobile Ad hoc Network, IPN wireless sensor networks, and other challenged network environments. The main purpose of DTN is to provide network solutions to meet the reliability of free transmission of asynchronous messages at limited end-to-end connection and resources. The research and development of DTN will be applied to the military war, disaster recovery, emergency rescue and other environment, which will benefit the development and strongly further the Intelligent, Ubiquitous, Integrative trend of Next Generation Network (NGN).

Fall (2003) suggested DTN architecture which advocates a change to the basic service model and system interface most Internet-style applications have become accustomed to, motivated by the exceptionally poor performance present in some networks. This is a comparatively radical approach; other approaches aim to “repair” underlying link performance problems or alter limited portions of the Internet architecture, such as routing,
with additional protocols in an effort to keep the current service model and existing TCP/IP based protocols constant. Because it provides a different type of network service than Internet, the DTN design makes a different set of choices in the architectural design space: messages versus packets, a form of hop-by-hop reliability and security versus end-to-end, name based routing versus address based routing, and a routing abstraction of partially-connected rather than fully-connected network graph. Interestingly, DTN can be overlaid upon the TCP/IP based Internet easily, and therefore remains compatible. This is not the most interesting case, however, as its strength lies in its ability to tie together dramatically different types of networks with unusual connectivity properties. As such, in some ways it makes more limited assumptions on the underlying protocol layers than IP does upon its underlying link layers.

Rumpold (2011) provides an overview of important transmission protocols for a certain class of challenged heterogeneous networks commonly termed delay- or Disruption Tolerant Networks (DTN). They outlined the basic requirements and limitations for these protocols, including the Bundle Protocol and the LTP and Saratoga convergence layer protocols, sketch their respective solution approaches and provide and overall comparison. Finally, discussed about some inherent shortcomings and operational challenges of the bundle protocol specification regarding areas of reliability, routing and time synchronization.

### 2.7.1 Delay Tolerant in Video Streaming

There are number of techniques proposed for solving issues in video streaming and this section discusses some of the techniques about the video streaming issues.

Geun-Hyung Kim (2014) discussed Bandwidth Allocation Mechanism for Mobile P2P in the Wireless LAN. The rapid increase of
mobile smart device with multimedia functionalities accelerates the IP-based live video internet streaming or VoD in the wireless networks. In addition, the IEEE 802.11 standard wireless networks have been developing to managing praising demands of new applications like video streaming. Mobile Peer to Peer (P2P) streaming architecture has been considered as a promising approach to deliver media streams over the wireless networks due to its scalability and efficiency. In IEEE 802.11 wireless network, the AP or node handles packets kept in the queue in the same way. As a result this procedure causes the performance degradation of mobile P2P streaming. They explored the effects of overlay topology on overall throughput and described the adaptive band width allocation mechanism for mobile P2P streaming system.

In P2P VoD Streaming (Debjani Ghosh et al. 2014), present a review on methods which address some current design issues like reducing the server stress because of asynchrony, building efficient P2P-VoD applications with interactive services and managing peer churn as well as the time-varying characteristics nature of network.

In addition to these issues, also discussed the challenges in deployment of P2P-based VoD systems with additional end user experience features like on demand watching of segmented videos, on-the-fly creation of playlists and so forth over best-effort Internet.

Peer startup process and initial offset placement in peer-to-peer (P2P) live streaming systems (Chungxi Li et al. 2013), measure and study the peer startup process in P2P live streaming systems and focus on a critical issue in this aspect: How a peer initializes its buffer status when it joins a channel, i.e., initial offset placement of the peer’s buffer in the startup stage. They built a general model of peer startup process in chunk-based P2P streaming systems and present two initial offset placement schemes we inferred from the measurement results of real systems: Fixed Padding (FP)
scheme and Proportional Placement (PP) scheme. With FP scheme, the initial buffer offset is simply set to the offset reported by the reference neighbor peer of the new peer plus a fixed padding. With PP scheme, the initial buffer offset is set to the offset of the reference neighbor peer plus an advance proportional to the reference neighbor peer’s offset lag or buffer width. Evaluated the performance of these two schemes, and find that the FP scheme, although simple, is not practical to be adopted in real P2P live streaming systems, and PP scheme is stable when the placement is based on offset lag, but will be unstable when it is based on buffer width if the chunk fetching strategy and neighbor peer selection mechanism are not properly designed. Then they reported with the detailed measurement results of PPLive and UUSee, two popular commercial P2P streaming systems.

Ali SS (2007), presented a Smooth Cache which is a peer-to-peer live video streaming (P2PLS) system. The distinct of Smooth Cache is threefold: i) the first P2PLS system is built as the relatively-new approach to support HTTP as the transport protocol for live content, ii) it supports both single and multirate streaming modes of operation, and iii) in Smooth Cache, recent advances in application-layer dynamic congestion control is used to manage priorities of transfers based on their urgency. They started by clarifying why the HTTP live streaming semantics render a significant number of the current suspicions utilized as a part of P2PLS conventions out of date. Later, they presented the design beginning with a standard P2P caching model. We, then, demonstrate various enhancements in the related aspects of neighborhood management, up loader selection and proactive caching. At last, assessments are done on a real yet instrumented test network. The outcome of the result shows that substantial traffic savings can be achieved on the source of the stream without having major degradation in end user experience.
In Incentive-Based Bandwidth Auction for Scalable Streaming in Peer-to-Peer Networks (Lin Chen et al. 2012), an incentive-based bandwidth allocation is proposed for scalable streaming in P2P networks. It is configured as decentralized dynamic auction games; herewith the peers can sell and bid the upload bandwidth to get the maximum individual benefit. With this unique characteristic of Scalable Video Coding (SVC), to avoid the bandwidth wastage and also to improve overall quality of the video, the content-aware prioritization of SVC is employed on the underlying bandwidth auction. Additionally, an incentive technique is applied to resolve free-riding issues.

The Playback policies for Live and On-Demand P2P Video Streaming (Fabio et al. 2012), supports further collaboration by providing storage and received blocks are redistributed later thus enables time shifting and video-on-demand based on integrated manner. However, video blocks are not always downloaded rapidly enough to be played back without intrusions. In such circumstances, the playback policy characterizes whether peers (a) slowdown the playback, waiting till blocks are found and downloaded, or (b) skip them, losing data. Thus, this paper explores reproducible way playback techniques for P2P video streaming systems. A review on at present utilized playback policies that demonstrates that current playback arrangements, required by any video streaming systems are defined arbitrarily, with a minimal techniques are applied. A set of five distinct policies are specified for playback and these policies are implemented in Live Shift based on this review aspects, relative aspects figure the characteristics of those policies under both under- and over-provisioned networks based on the playback delay experienced by users, sharing of skipped blocks, and sharing of sessions that failed. At last, playback policies with most appropriate characteristics required for live or on-demand frameworks are determined.
Abdulai et al. (2009) suggested an Optimal Link Managed on Demand (OLMOD) routing protocol to enhance the performance of MANET. In this method the discovered routes are not discarded up to an optimal time. The node discards the path only if there are no such transmissions in the link at a specific time. To reduce the number of RREQ packet transmitted a probabilistic method is suggested for mobile ad hoc networks. The method has reduced the routing overhead and also increased the throughput. Another probabilistic routing with energy efficiency towards internet is discussed in (SH Park 2014). The method describes an Energy Efficient Probabilistic Routing (EEPR) algorithm that restricts the RREQ messages in a stochastic manner. This reduces the power overhead and increases the lifetime of the network using the flooding algorithm.

Probabilistic routing approaches are considered to control the dissemination of the routing control packets. A probabilistic method for on-demand route discovery (Zhang et al. 2005) has been defined, whereas the packet forwarding probability for an RREQ packet is determined by the number of duplicate RREQ packets received at a node. Gossip-based route discovery approach using the AODV protocol (Hass 2006) uses some optimizations of the fixed probabilistic methods such as two threshold schemes. The disadvantage of this approach is that the decision to rebroadcast a RREQ by an intermediate node is predetermined by its predecessor that is independent of its local topological characteristics.

The methods discussed in this section have the problem of poor video streaming quality and latency. Hence, new methods have been proposed in this work for enhancing the quality of video streaming.