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A review over MANET- Issues and Challenges

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Abstract: **Mobile Ad-hoc Networks (MANETs) is an assortment of mobile node where the nodes move randomly and coupled by wireless link. MANET is a self organized as well as self configured network. The major application areas where MANET is used are military purpose, battlefield operation, urgent business meeting, personal area network, disaster relief operations etc. Routing in MANET is serious issue because network topology which is changeable due to nodes mobility. Routing algorithms uses specific metrics to determine the optimum path between senders and receivers such as shortest minimum cost, minimum total power transmission and min-max power cost etc. Many routing protocols have been purposed in last few years. This paper provides a universal thought of routing protocols and also brief indication over "Location Based Routing Protocols".**

Keywords: MANET, Routing, Zone, Routing Metrics, Location Area.

I. INTRODUCTION

Wireless network are of two types: Infrastructured or Infrastructure-less. In Infrastructured wireless networks, at the time of communication nodes can move, the base stations are fixed and nodes communicate with in the range of base stations [1]. Fig. 1 depicts Infrastructured wireless networks in which nodes are connected by hubs which are fixed access point. In infrastructure-less or Ad-hoc wireless network, at the time of communication nodes can move, no fixed base stations are there in the network and the nodes in the network act as routers. In the Ad-hoc network the mobile nodes to form their own network dynamically establish routing among themselves. Infrastructure-less network is shown in fig.2 in which no access point to connect nodes.

MANET is an emerging, exciting and important technology these days due to the fast growth, enhancement in wireless devices. A MANET is an assortment of wireless mobile nodes and these nodes allow to forward packet and to communicate beyond their range of direct wireless transmission [2].

Fig: 1: Infrastructured Network

Node communicates with other node that exists within the transmission range and intermediate node is required to communicate with the node that subsists beyond the range.
Mobile nodes in MANET communicate with each other without any infrastructure. On wireless networks there is a great impact of MANET, no basic network devices are there to transfer data among nodes such as routers or access points. Each node act as a router to establish a route as well as transfer data between multiple hops [3].

Fig: 2: Infrastructure-less or Ad-hoc Network

Nodes in MANET have limited power so failure of power in a mobile node not only affects the node itself but affect the overall network lifetime [4].

1.1. **History Of Ad-hoc Network:** Ad-hoc network is basically consists of Ad-hoc and network in which the word 'Ad-hoc' is a Latin word specifies the meaning 'for this' or 'for this only' and the word network specifies a set of computers / mobile nodes connected via wired or wireless link. We can categories this type of network on the behalf of era as follows:

- First Generation (1970s)**:**The first ad-hoc network system was Packet radio networks for military purpose in 1970 and next development is carrier sense medium access (CSMA).In 1971 university of "Hawaii" first combined radio communications and computer networks ."ALOHANET" an experimental network for bidirectional communications was developed.
- Second Generation (1980s to the mid 1990s)**:** Further advancement of the previously build Ad-hoc network structure e.g. global mobile information systems, near term digital radio (NTDR).Arial location of hazardous atmosphere(ALOHA) then evolved into the survivable adaptive radio networks (SURAN) program in the early 1980s for military purpose.
- Third Generation (late1990s to the 2000s)**:** Also branded as commercial Ad-hoc network systems arrived with notebook computers and other viable communications equipment. At numerous research conferences the idea of an assortment of mobile nodes was proposed e.g. Bluetooth, Ad-hoc sensor networks [12, 13].The developments are JTRS(joint tactical radio system) in 1996,IETF published several drafts about routing protocol of MANET in 2000,IEEE workshop on mobile ad hoc networking and computing was established in 2000.
- Fourth Generation (2000s onwards)**:** The developments are use of mobile Ad-hoc routers to provide internet connectivity to mobile users, distributive collaborative computing, and distributed sensing networks, disaster recovery networks [15, 16, and 17].

1.2. **Necessitate of MANET:** In wired network computers can be wired to one another by using devices like hubs, switches, or routers etc .There is a fixed centralized infrastructure requirement in wired network. Infrastructure may not be present in a disaster area or war zone, for short-range radios infrastructure may not be practical e.g. Bluetooth so then MANET is used. Wired networks are difficult to install, costly and more time consuming as compare to wireless. Wires from each room within the home are a difficult task and disorganized. Adding large number of computer is expensive. In MANET every node acts as a router and can forward packets of data to other nodes .Collection of mobile nodes forming short live or temporary networks without any centralized structure and can turn the dream of networking at any place and at any time into reality.

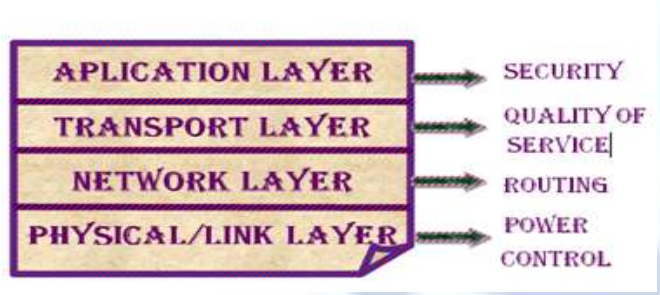

Fig 3: MANET Challenges at different layer

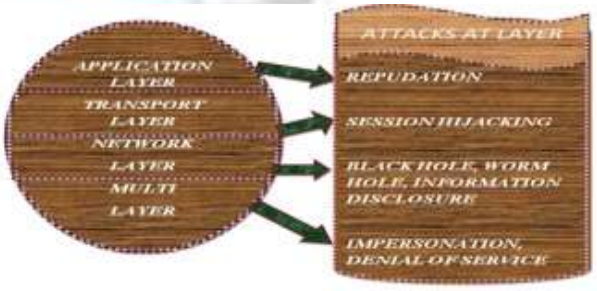

Fig .4 MANET security attacks at different layers

1.3. **Challenges of Mobile Ad-Hoc Network:** A number of challenges are given below which affects the MANET. Fig.3 depicts assorted MANET challenge where security related challenge is at application layer, quality of service at transport layer, routing at network layer, power control at link/application layer.

- Self Operated And Infrastructure Less: When nodes move out of the range, network has to realign itself to update dynamic link information.
- Dynamic Topology: In an arbitrary manner mobile nodes can be connected dynamically. Links of the network vary timely and are based on the proximity of one node to another. When node in a network moves how the topology of the network changes. Link reliability's computation can be safe or unsafe. Breakage of link can be controlled, if we priory estimate its reliability and correlate a trust level accordingly .For put into action, on the basis of mobility and resource availability an off-line certificate must be issued by several other nodes in the network.
- Limited Resources: Each Mobile node in the network have to work with limited power and storage capacity, computation capability. Limited number of applications and services to be supported by mobile node due to limited energy and processing power. A threshold value is set for the power, energy, computation capacity and other resources. When a node receive a packet, node check its value, if value is less than threshold then choose another neighbor node of higher value.
- Scalability: Routing should proficiently adjust itself to the network size. The routing protocols engaged for packet forwarding should be accomplished to balance for a network with a large number of nodes, where the nodes entered dynamically into the network continuously [23].
- Network Configuration: The dynamic nature of MANET infrastructure is the reason for dynamic connection and disconnection of the variable link**.**
- Error Prone State: The characteristics of the links in a wireless network typically vary, so to find out alternate's routes, interaction between routing protocols is required.

- Limited Physical Security: Mobile wireless network are generally more prone to physical security threats than wired cable network. Existing link security techniques are often applied within wireless networks to reduce security threats. Fig .4 gives you an idea about diverse MANET security attacks at different layers. Mobility implies higher security risks shared wireless medium accessible to both legitimate network users and malicious attackers.
- Blurring of IP Address: Nodes can be used as host as well as router so not cleared which IP address is intended for host and which IP address is intended for router**.**
- Bandwidth Constraints: The limited capacity of radio band to offer data rates becomes a challenge in mobile ad hoc networks. Forwarded data packet is embedded with some information regarding the bandwidth it requires for its relaying and processing .Intermediate node first check and then takes action.

1.4. **Application Area:** The mostly discussed application scenario for MANET are tactical network, sensor network ,emergency services, home and enterprise ,commercial, education, context aware services etc.

- Tactical Network: MANET can be used for battlefields, military communication and operations as .The establishment of temporary communication without any pre-installed infrastructure, the IEEE 802.11 wireless LAN standard family (1997) and Bluetooth (2001) are used. The Ad-hoc network are very important area in this time and very useful for the military (battlefield) and for the disasters (flood, fire and earthquake), meetings or conventions in which people wish to quickly share information, secure communication previously tracking of path.
- Sensor Networks: Collection of embedded sensor devices used to collect real-time data to mechanize everyday functions. Each node collecting sample data, and then forwarding data to centralized host for processing using low homogeneous rates. Sensor network can be used inside the home (smart sensors and actuators embedded in consumer electronics such as fire alarm, security alarm), chemical/biological detection, body area networks, data tracking of environmental conditions such as animal movements.
- Emergency Services: Sensor network can be wear as search and rescue operations in the desert in the mountain, replacement of fixed infrastructure in case of environmental disasters, policing, fire fighting, supporting doctors and nurses in hospitals.
- Home and Enterprises: Use the wireless networking in home or office, conferences, meeting rooms, personal area networks, and personal networks e.g. white board networking.
- Commercial: E-commerce(anytime and anywhere), inter-vehicle networks as depicted in fig.5, business(dynamic database access), mobile offices, vehicular services(guidance of road or accident),road and weather conditions transmission, taxi cab network, sports stadiums, trade fairs, shopping malls, networks of visitors inside the airports.

Fig: 5 Inter-Vehicle Networks

- Education: We can use MANET in classrooms, Ad-hoc network when they make a meetings or Lectures, multi-user games, wireless P2P networking, outdoor Internet access, and robotic pets.
- Context Aware Services: Follow-on services such as call-forwarding, mobile work space, Information **s**ervices, location specific services (push, e.g. advertise location-specific service like gas stations, Pull e.g. location-dependent travel guide), time dependent services, infotainment (tourist's information).

1.5. **Measurements Metrics:** A number of qualitative and quantitative parameters are used to compare the routing protocols which are as follows:

- Routing Overhead: Number of packets sent for route discovery and route maintenance and measured in the unit of number of bits in meters per unit time.
- Packet Delivery Ratio: Ratio between number of packet deliver and actual received packet.
- Throughput: Total number of bits per sec forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network. Throughput is measured as number of packets passing through the network in a unit of time.
- Network Load: The total data traffic received from higher layers of the MACs that is accepted as well as queued for transmission and measured in bits per second [29].
- Retransmission Attempts: Is total number of retransmission packets in the network until either the packet is successfully transmitted and measured in number of packets [29].
- Media Access Delay: The time a node takes to access media for starting the packet transmission is called as media access delay. When the packet is sent to physical layer first time at that time delay is recorded.
- Optimal Path: Difference between the actual and best possible optimal path**.**

- Lifetime: Two parameters are considered for the lifetime which are node lifetime and route lifetime
  1. Node Lifetime: The time for which node is available on the basis of remaining battery life.
  2. Route Lifetime: The lifetime of route which is based upon the time in which route doesn't break mean route is active.

II. ROUTING PROTOCOL

Routing is used to find as well as maintain routes between nodes in a rapidly changing topology with possibly unit-directional links, by using minimum resources [6].Whenever a packet via number of nodes needs to be transmitted to a destination a routing protocol is needed. Routing protocols deliver the packet to the correct destination via finding route for packet [1]. For efficient routing a routing protocol has to follows a quantity of points which are as follows:

- Routing Protocol must be Aware of Power.
- Quality of Service should consider in routing protocol.
- Routing Protocol should be less vulnerable to security attacks.
- Routing Protocol should be less proactive than reactive to avoid overhead.
- Time synchronization concept should be in routing protocol [3, 5].

2.1. **Routing Metrics:** To determine the optimum path between senders and receivers specific metrics are used by routing algorithm which are as follows:

- Minimum Power Routing: To get a packet from source to destination, minimizing the amount of power required as well as energy per bit.
- Multi-Path Battery Cost: To balance the energy consumption of all the nodes in a static wireless Ad-hoc network.
- Power Controlled MAC: Source uses an appropriate power level to transmit the packet and increase channel utilization.
- Battery Cost Aware Routing: Three different types of batter-cost–aware routing algorithms exists which are:

1. Minimum Battery Cost: Minimize the total battery used for all nodes on the routing path.
2. Min-Max Battery Cost: To avoid the routes with the nodes which have least battery remaining.
3. Conditional Max-Min Battery Capacity: Route is chosen on the basis of minimum total transmission power [30, 31].

III. LAYERED METHDOLOGY

Most of the network protocols are created with a modular design methodology. The modules of a synthesized protocol are arranged in a vertical stack. The protocol stack is a generic model of the organization of a layered communication system. There are several reference models for describing the layers of a communication network, such as the open system interconnection (OSI) and the transmission control protocol/ internet protocol (TCP/IP) reference model. The objective for organizing the network interface into layers as depicted in fig: 6 is simple and clear: management of a single complex module is not easy as a general design rule in the broad field of technology.

3.1. **Physical Layer:** The physical layer is the modem hardware in simple terms. Electronics parts of the physical layer are the antenna and the transmitter/receiver as an e.g. in a wireless node. Main functions are Modulation and coding of the physical layer .IEEE protocols at physical layer are:

- To transmit data at 10 Mbps 802.3 (Ethernet) is used which is a logical bus network .To every computer on the network data is transmitted [43].
- To transmit data at 4Mbps or 16bps 802.5 (Token Ring) is used which is a logical ring network. Each computer is branching of hub so it resembles more like star [78].
- 802.4 (Token Passing) uses a token-passing scheme which is a bus layout. Computers that are addressed respond receive all the data. A token that travels the network determine which computer is capable to broadcast [78].

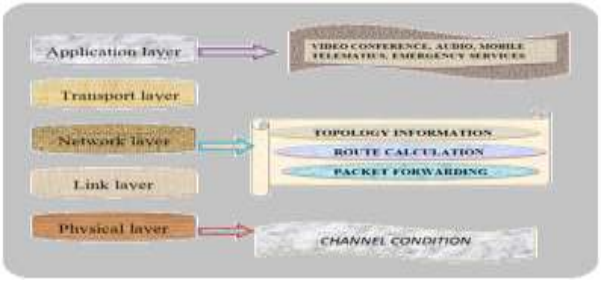

Fig 6: Layered Architecture

3.2. **Link Layer**: The limited bandwidth of the wireless channel combined with radio propagation loss and the broadcast nature of radio transmission make communication over a wireless channel inherently unreliable. Link-layer protocols are used to add information bits to the data bits to protect them against channel errors. Forward error correction (FEC) protocols add controlled redundancy to the data, in order to enable reliable transmission of data over unreliable channels [61]. Typical channel coding systems contain a source code, to reduce redundancy from the data, followed by a channel coder that adds controlled redundancy to the compressed data. The channel-coded data are sent over a channel, where noise is added to the stream. The channel decoder at the receiver produces an estimate of the source-coded stream, which is sent to the source decoder to extract the data to be given to the application. This system is depicted in Fig. 7.The protocol used at link layer are: , ARC Net (Attached Resource Computer Networks) [87],CDP (Cisco Discovery Protocol), LLDP (Link Layer Discovery Protocol) [44], FDDI (Fiber Distributed Data Interface) [40] , HDLC (High-Level Data Link Control) [39] , RPR (Resilient Packet Ring) [53],SLIP (Serial Line Internet Protocol) and STP (Spanning Tree Protocol) [78],SMLTP (Split Multi-Link Trucking Protocol), Frame Relay ,LAPD (Link Access Procedures On The D Channel) [84,60]and PAGP (Cisco Systems Proprietary Link Aggregation Protocol) [65],PPP (Point-To-Point Protocol) [78],PPTP (Point-To-Point Tunneling Protocol) [78], VTP (VLAN Trucking Protocol) [79],LACP (Link Aggregation Control Protocol) [66], ,SDLC (Synchronous Data Link Protocol) [78], HDLC (High-Level Data Link Control) [78], SLIP (Serial Line Interface Protocol) [81], LAP (Link Access Procedure) [86], LLC (Logical Link Control)[85] etc.

3.3. **Network Layer:** In MANET the source and the destination are not in the direct transmission/reception range of each other. Multi-hop forwarding (one of the most important advantages of MANET) is used for the nodes that are not in direct communication range such indirect communication through multi-hop forwarding is called routing. Set up and maintain of routes from a source to any desired destination is the responsibility of the network layer. The network layer utilizes the MAC layer, which deals with single-hop data forwarding, to enable such end-to-end (Multi-Hop) data forwarding. The network layer needs sufficient information about the topology of the communication network to provide efficient routes.

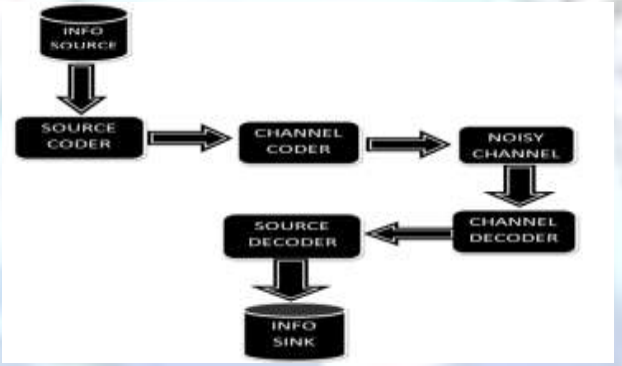

Fig 7: Block diagram of a data transmission system

There are two main function of the network layer: route discovery and route maintenance. Route discovery is used to find a route from a source to a destination, although route maintenance is used to maintain an existing route as the topology changes suitable to node mobility. Network protocols provide link services, retransmission request, routing information, handle of address and error checking. Network protocols as Ethernet or token ring identify rules for communicating in a particular networking environment. Protocols at network layer are: RIP (Routing Information Protocol) [78], AppleTalk data-transport protocol- DDP (Datagram Delivery Protocol), for packet forwarding and routing-IPX Netware's protocol suit, (IP TCP/IP protocol). Protocols for message transfer (IPv4, IPv6) ,CLNP (Connectionless Network Protocol)[42] ,IPSec-enables encryption as well as authentication of every IP packet that moves in the data stream and BGP (Border Gateway Protocol) [78],ICMP (Internet Control Message Protocol)[78]used by O.S of network to send error message that service is unavailable ,IGMP (Internet Group Management Protocol) [78] , EGP (Exterior Gateway Protocol) [78],SCCP(Signaling Connection Control Part) ,IGRP (Interior Gateway Routing Protocol) ,IS-IS (Intermediate System-To-Intermediate System) [88],OSPF (Open Shortest Path First) [78], EIGRP (Enhanced Interior Gateway Routing Protocol) ,NDP (Neighbor Discovery Protocol) ,GDP (Gateway Discovery Protocol)[78] . Tree based Multicast routing protocols are WBM (Weight Based Multicast Routing) [76],MANSI(Multicast for Ad Hoc Networks with Swarm Intelligence) [57],ABAM (Associatively- Based Ad hoc Multicast Routing) , MZRP (Multicast Routing Protocol Based on Zone Routing) , AMRIS (Ad Hoc Multicast Routing Protocol utilizing Increasing ID-Numbers) ,MAODV (Multicast Ad hoc On-Demand Distance Vector Routing Protocol) [71], PLBU (Preferred Link-Based Unified Routing Protocol) ,DDM (Differential Destination Multicast Routing Protocol) [70],MCEDAR (Multicast Core-Extraction Distributed Ad-Hoc Routing) ,BEMRP (Bandwidth-Efficient Multicast Routing Protocol) [73],PLBM (Preferred Link-Based Multicast Protocol) [74],ASTM (Adaptive Shared-Tree Multicast Routing Protocol)[28]. Mesh Based Multicast Routing Protocols are ODMRP (On-Demand Multicast Routing Protocol), NSMP (Neighbor Supporting Ad Hoc Multicast Routing Protocol) [46], DCMP (Dynamic Core-Based Multicast Routing Protocol) [78], and FGMP (Forwarding Group Multicast Protocol) [38], CAMP (Core Assisted Mesh Protocol) [37].

3.4. **Transport Layer:** The transport layer is accountable for end-to-end connection establishment, end-to-end data packet delivery, congestion control, and flow control. Transport protocols help to create communication sessions between computers and guarantee that reliably data is move between computers. Protocols used at transport layer are : TCP is used for sequenced data delivery guarantee, Part of Novell's IPX/SPX protocol suite –SPX is used [63], data-transport protocols and Apple's communication-session - ATP (Apple Talk Transaction Protocol) [48] and DNS (Domain Name System) [49],implementation of the IPX/SPX protocol-NW Link , between computers to establishes communication sessions NetBIOS [78] and provides the basic data transport services NetBEUI) [63],DCCP (Datagram Congestion Control Protocol) [47] ,ESP (Encapsulating Security Payload Over IP Or IPSec) [64] ,GRE (Generic Routing Encapsulation For Tunneling) [78], UDP (User Datagram Protocol) [56],SCTP (Stream Control Transmission Protocol) ,SPX (Sequenced Packet Exchange) ,TCP (Transmission Control Protocol) [41] etc.

3.5. **Application Layer:** The application layer with which a user interacts is application-specific. All the other layers are used to create a seamless interface for the networking needs of the application layer. The functionalities of the other layers change on the basis of requirement of application. Numbers of identifications are there like communication partners, privacy are considered, quality of service, user authentication, and a number of constraints on data syntax are identified. The application services provided by application layer are file transfers, e-mail and network software services. Protocols used at application layer are: for e-mail –SMTP (Simple Mail Transfer Protocol) , web application, streaming multimedia application-HTTP (Hypertext Transfer Protocol) , for file transfer – FTP (File Transfer Protocol) [55],DSNP (Distributed Social Networking Protocol) ,DHCP (Dynamic Host Configuration Protocol) [67] ,for simple mail transfer-MTP ,GMTP (Group Mail Transfer) , TFTP (Trivial File Transfer) [54], to synchronize the clocks of computers on a network-NTP (Network Time Protocol) [78], to retrieve email that was stored- POP3 (Post Office Protocol 3) [78], APPC works in the presentation layer of the OSI reference model ,so it is considered as an application protocol, APPC uses the LU 6.2 protocol which works in both the transport as well as session layers of the OSI reference model-APPC (advanced program-to-program communication) so it is also considered a transport protocol , to monitor network and network component-SNMP(simple network management)[78].For dispensation data locally on logging into remote host-TELNET [68], IRC(Internet Relay Chat) [83],ISUP(ISDN User Part) [69]for file access control- FTAM (File Transfer Access And Management) [82],for client/server request/response-MSMBs (Microsoft Server Message Blocks) ,service protocol-NCP(Novel Net Ware Core Protocol)along with Novell client shell or else redirectors, Apple's networking protocol suite- AppleTalk and AppleShare, for remote file access AFP (Apple Talk Filing Protocol) [72],Gopher (A Hierarchical Hyper Linkable Protocol) , BOOTP (Bootstrap Protocol) [78],LDAP (Lightweight Directory Access Protocol) [59].MIME (Multipurpose Internet Mail Extensions) [78],MSNP (Microsoft Notification Protocol) ,MAP (Mobile Application Part) [77],DAP (Data Access Protocol) ,MSNP (Microsoft Notification Protocol) used by windows live messenger) ,MAP (Mobile Application Part) [90],AFP (Apple Filing Protocol), BAC net (Building Automation And Control Network Protocol) [80],DSM-CC (Digital Storage Media Command And Control) [51],DSNP(Distributed Social Networking Protocol) ,TCAP (Transaction Capabilities Application Part) [52], Web DAV (Web Distributed Authoring And Versioning) [58],XMPP(An Instant-Messaging Protocol) ,SOAP(Simple Object Access Protocol) ,SMB (Microsoft Server Message Block Protocol) ,STUN(Session Traversal Utilities For Nat) ,TUP(Telephone User Part) ,SSH(Secure Shell) [89], (Remote Desktop Protocol) [78],Rlogin(A Unix Remote Login Protocol) [78],DHCP (Dynamic Host Configuration Protocol) [78],SISNAPI(Siebel Internet Session Network API) [65].

IV. CLASSIFICATIONS OF ROUTING PROTOCOLS

Routing protocols can be mainly arranged into the two categories: Table Driven or proactive Protocols and On Demand or Reactive Protocols, Hybrid Routing Protocols as depicted in fig.10

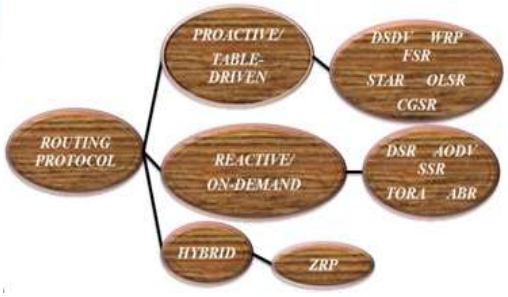

Fig:10: Routing Protocols

4.1. **Table Driven /Proactive Routing Protocols**

Routing tables are maintained by each node which stores information of next hops/subnet. All nodes keep on updating these tables periodically. Drawback of this routing causes more overhead ,not used for large topology network, consumption of more Bandwidth , If the network topology changes too frequently, might be very high cost of maintaining the network, information about actual topology might even not be used if network activity is low [1, 5, 7].

4.1.1. **Destination Sequenced Distance Vector**

In DSDV updates are periodically transmitted, packet size grow when number of nodes in network increase so more bandwidth is used .Overhead is increased .Loops can occur when network is reacting to change of topology .DSDV has high degree of complexity during link failure because it use shortest distance vector routing[45].

*4.1.2.***Wireless Routing Protocol**

Four tables are maintained so wastage of memory. To update routing information hello packets are used so more network resources are used .Distance Vector Routing is used so, more complexity during link failure. In WRP node broadcast packet to nodes which are in range of node and has no information about the node which are out of range [9].

*4.1.3.***Cluster Head Gateway Switch Routing**

CGSR uses clustering algorithms so, in maintenance and formation of cluster more overhead and complexity is introduced s .More memory is wasted in maintenance of cluster table. In MANETs network topology changes due to which more time is required in selection of cluster head [1, 6].

*4.1.4.***Source Tree Adaptive Routing**

Initial node search process requires more time. Network is slow down because same response packet is received by intermediate node. To find a suitable path rebooting of the network is required. Finding the stability of the recorded link is difficult because link state information does not time out.

4.1.5. Optimized Link State Routing

In OLSR error recovery service is not good. OLSR protocol needs that each host periodic sends the updated topology information throughout the entire network, this increase the protocols bandwidth usage. OLSR protocol is not well suited for the application which has long delay in transmission of data packets. Communication is not concentrated between whole networks [34].

4.1.6. Fisheye State Routing

FSR is not efficient for large network. If the distance between nodes is large then in FSR information is not accurate.FSR semi integrated circuit is not well suited for MANETs. Response ability of other node is reduced because intermediate contains wider information [7, 9].

4.2. **On-demand /reactive routing protocols**

On demand routing protocol establishes route to the destination only when the need arises. Periodically transmission of topological information of the network is not needed.Table.1 is comparison of on-demand and table driven routing protocol on the basis of different parameters.

Table 1: Comparison of On-Demand and Table Driven

Parameters	On Demand	Table Driven
Availability of Routing Information	Routing Info is Available when needed	Always available in spite of need
Routing Philosophy	Routing philosophy is Flat	Mostly Flat not for CGSR
Periodic route updates	Requirement is not there	Periodic update is Required
Coping with Mobility	Using Localized route discovery in ABR	Inform other nodes to achieve consistent routing tables
Signaling Traffic Generated	As mobility of active nodes increase ,signaling traffic also grow as in ABR	Greater than that of On Demand Routing
QOS Support	Few Can Support QOS	Mainly Shortest Path as QOS Metric
Routing Overhead	comparative to the size of the network despite of network traffic	Proportional to the number of communicating nodes and increases with increased node mobility
Dealing with Link Breakage	Propagate information to neighbors to maintain consistent routing table	Use route discovery

4.2.1. **Dynamic Source Routing**

In DSR only the nodes who needs to communicate maintains the route so, overhead of route maintenance is reduced .Route caching concept is used by which route discovery overhead is reduced. Same local cache is used by intermediate nodes by which

a single route discovery may give up several routes to the destination. Source routing grows the packet header size with route length, flood of route requests may potentially reach all nodes in the network, and Stale caches will lead to increased overhead. No of collision are more in DSR More maintenance is required in DSR [32].

4.2.2. Ad-hoc on Demand Distance Vector

In AODV to handle the routing process no centralized administrative system is required. AODV have a propensity to reduce the control traffic messages overhead at the cost of increased latency in finding new routes and try to keep overhead of message small. AODV is a loop free and avoids the counting to infinity problem, which were in classical distance vector routing protocols, by the convention of the sequence numbers. AODV reacts comparatively quickly to the topological changes in the network and updating only the hosts that may be affected by the change. Overhead of maintaining sequence number table is increased. This problem can be further reduced [33, 36]. Goyal et al. [91] evaluated and compared AODV, DSDV, and DSR using NS2.

4.2.3. Temporary Ordered Routing Protocol

TORA is one of the largest routing protocols. TORA require extra memory for different operations because structure is maintained by each node which describe node's height and status of connected link .In TORA there is a more bandwidth and CPU requirement. Instability problem is there in TORA as count to infinity problem because TORA uses inter nodal co-ordinates [34].

4.2.4. Associativity Base Routing

ABR deadlock and packet duplication does not occur. Broken link is prepared locally. Routing overhead and extra memory is used by maintaining associativity table. Longest path is chosen on the basis of stability so more work is required on this issue [7, 9].

4.2.5. Signal Stability Routing

In SSR route discovery is initiated from source in case of failure of link so more bandwidth or resources are used. Large number of packet dropped because no mechanism to differentiate between packet .Failure of intermediate node to reply to route request packet adds more delay [35].

4.3. Hybrid Routing Protocols

Hybrid routing protocols is combination of both proactive and reactive routing protocols to balance the delay and control overhead. For local area proactive is used and for remote area reactive routing protocol is used . The hybrid routing protocols disadvantage is that the nodes that have high level of topological information maintains more routing information which lead to more memory as well as power consumption [3].

4.3.1. Zonal Routing Protocol

Routing overhead increased due to maintenance of zone and more time is required. Communication overhead and delay is decreased .To decides the size of zone is an important issue. ZRP is not suited for all type of network [3, 9].

4.4. Comparison of Routing Protocols

Table 1 compares the on demand and table driven routing protocol on the basis of different parameters. Table 2 is performance comparison of DSDV, WRP, TORA routing protocols. Table 3 give performance comparisons of CGSR, FSR, OLSR .Table 4 is performance comparison of DSR, AODV, OLSR. N is number of nodes, D is diameter of the network and H is height of routing tree.

Table 2: Performance Comparison of DSDV, WRP and TORA

Protocol	Time Complexity	Communication Complexity	Loop Free	Route maintained in	Number of required table	Routing Metric	Update Transmitted to
DSDV	O(D)	O(N)	Yes	Route Table	2	Shortest Path	Neighbors
WRP	O(H)	O(N)	Yes but not instantaneous	Route Table	4	Shortest Path	Neighbors
TORA	O(2*D)	O(2*N)	Yes	Route table	2	Shortest Path	Neighbors

Table 3: Performance Comparison of CGSR, OLSR and FSR

Protocols	Communication Complexity	Routing Metric	Loop Free	Time Complexity	Routing Philosophy	Update transmitted to	Use Sequence Number
CGSR	O(N)	Via Critical Nodes	Yes	O(diameter of the network)	Proactive, distance vector	Neighbor and cluster head	No
OLSR	O(N)	Shortest Path	Yes	O(diameter of the network	Proactive, Link State	Neighbor node	Yes
FSR	O(N)	Shortest Path	Yes		Proactive, link state	Neighbor node	Yes

5. Why Location Aided Routing

Table driven routing protocol requires a large amount of storage space to store the information and concerning whole of the network which is not possible in case of small mobile devices. As well as they perform large computations in order to select the best node due to which there is a loss of battery bandwidth consumption was reduced by the Location Aided life[28].On-demand routing protocols were based on flooding the routing packets in all directions irrespective of the location of consumption and increases the network load. This bandwidth consumption was reduced by the Location Aided Routing Protocols. .These location based protocols uses the Global Positioning System (GPS) to find the direction of propagation of the packets. Bandwidth consumption can decrease by finding the direction of propagation. [26].Large no of protocols is there which are as follow:

5.1. Location Aided Routing

LAR is an on-demand routing protocol which is a modified flooding algorithm. LAR exploit location information to Limit the scope of the route request flood. Location information is obtained from a GPS. LAR uses the location information to identify the request zone and expected zone as depicted in fig.8. Request zone in this protocol is the rectangular area including both sender as well as receiver. By decreasing the search area, this protocol leads to the decrease in routing over heads. The expected zone is defined as the region that is predictable to grasp the current location of the destination [22, 28].

Table 4: Performance Comparison of DSR, AODV and OLSR

Protocol	Time Complexity	Route Maintained In	Route metric method	Routing Message Overhead	Average end to end delay	Throughput	Communication complexity	Update transmitted to
DSR	O(2*D)	Route cache	Shortest path Or next path Available	Low, increases With an Increase in the number of Nodes	Degrade when Number of Nodes increase in the Networks	Increases Better than DSDV	O(2*N)	Source
AODV	O(2*D)	Route table	Fresh and shortest path	Increases Proportionally With an Increase in the Number of Nodes	Performance Degrade with Number of Nodes Increase in The Networks	Best	O(2*N)	Source
OLSR	O(D)	Route table	Shortest path	Increases With an Increase in The nodes	Better Performance With less Number of Connections	High when Compared With other Link state Protocols	O(N)	Neighbor node

- **Expected Zone**

Consider, source node S wants to send the data packet to destination node D at time T. S knows the location of D at time Ti, velocity (VD) of D with which D is traveling. In any direction distance traveled by D can be calculated as r = VD (T – Ti).

- **Request Zone**

Request zone is the area where the request packets are sent or broadcast to find a path from source to destination. In the traditional routing algorithms it is the complete network. In AODV, DSR, etc. RREQ packet is broadcasted in all directions to find the optimal path from source to the destination node. LAR tries to minimize the request zone confining it to the smallest rectangular area containing both sender as well as receiver [22].

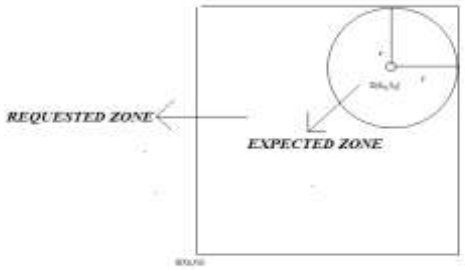

Fig: 8 Requests and Expected Zone in LAR

5.2. Distance Routing Effect Algorithm For Mobility

DREAM protocol is table driven routing protocol. Routing Table in DREAM stores location information for every other node within the network to reduce overhead of route discovery. DREAM may be combination of proactive and reactive in nature. DREAM as proactive disseminate and cooperatively updating the location table entries for each other node. When a packet is send from node A to node B, node a looks up the table for location of B and forwards the packet to nodes, as the next hop node "in the direction" of B. [27].

5.3. Improved Location Aided Routing

LAR is location based technique which uses the concept of base line lying in between the source and destination node. The next intermediate node is chosen on the basis of closest line of sight. When the transmitting node verifies the distance of every neighboring node from base line and finds the closest neighbor to promote transmission. This process decreases battery life due to increase of delay in data [22, 28]. Large bandwidth is consumed in RREQ packet. More battery is used because forwarding node take decision on the basis of distance.

5.4. Location Aware Routing Protocol With Dynamic Adaption Of Request Zone

LARDAR is an on demand routing protocol. LARDAR use destination node location information which in turn decreases the area of request zone and velocity to reduce number of route request. Intermediate node is trigger by using more fresh location information of destination node and dynamic adaption of request zone technique is used. The information provide by precedent node to redefine a more precise request zone to improve the performance of routing protocol.[22,26].Large no of calculation so more battery loss.

5.5. Location Based Power Aware Routing

LARDAR uses the concept of Triangle zone along with the angles α and β. LBPAR also uses the concept of triangle zone but in its place of using the angular values in route request packet as in LARDAR, LBPAR use the concept of slopes of line. LBPAR finds an optimal path in terms of bandwidth consumption, power loss of a node. In Route discovery process source node S initiates a request to send the data packet to destination node D. m1 and m2 are the slopes of the line. The m1 and m2 will be the maximum and minimum slopes of line drawn between the source and any point in between these two tangents drawn from source to the expected zone. Source node S broadcast a route request packet to find the path. On receiving the RREQ packet node 'N' calculates the slope mN using its own location co-ordinates and source location co-ordinates. If its slope lies between the max and min slope i.e. ($m1 \geq mN \geq m2$) then node will again broadcast the packet otherwise node drops the packet. This routing protocol is used to routing packets between mobile nodes in an ad hoc network using the Global Positioning System [22].

Conclusion

A protocol is still required to deal with energy efficient issue. A number of protocols are there like LABPAR, LARDAR, DREAM, ILAR but still they have not consider energy efficient issue. Work is still left over in MANET to have efficient storage capacity, computation capability, and power.

References

[1]. Sunil Taneja and Ashwani Kush, "A Survey of Routing Protocols in Mobile Ad Hoc Networks", International Journal of Innovation, Management and Technology, 1, No. 3, August 2010.
[2]. Mr. Harish and Ms. Shweta Vincent, "A Survey on Routing Protocols in Mobile Ad Hoc Networks", International Journal of Computer Science and Management Research 1, No. 5, December 2012.

[3]. Vidya Shree.P and Sophia Reena.G, "A Survey of Various Routing Protocols in Mobile Ad-Hoc Networks", International Journal of Computer Science and Engineering Technology, 3, No. 7, July 2012.
[4]. Vinay Rishiwal, Mano Yadav, S. Verma, S. K. Bajapai, "Power Aware Routing in Ad Hoc Wireless Networks", International Journal of Computer Science and Technology , 9, No. 2, October 2009.
[5]. Mr. Chethan Chandra S Basavaraddi, Smt. Geetha N.B. M.Tech, "Current Project Work on Routing Protocols for Mobile Ad Hoc Networks: A Literature Survey", International Journal of Scientific and Engineering Research, 3, No. 5, May 2012.
[6]. Ipsita Panda," A Survey on Routing Protocols of MANETs by Using QoS Metrics", International Journal of Advanced Research in Computer Science and Software Engineering , 2, No. 10, October 2012.
[7]. G. Vijaya Kumar, Y. Vasudeva Reddyr, Dr.M.Nagendra, "Current Research Work on Routing Protocols for Mobile Ad Hoc Networks: A Literature Survey", International Journal on Computer Science and Engineering, 2, No. 3, 2010.
[8]. Hemant Nara,Yufei Cheng,Egemen K CetinKaya,Justin P. Rohrer,James P.G Sterbenz,"Destination Sequenced Distance Vector Routing Protocol Implementation in ns3", March ,2011.
[9]. Humayun Bakht," Survey of Routing Protocols for Mobile Ad-hoc Network", International Journal of Information and Communication Technology Research, 1 ,No. 6, October 2011
[10]. Saleh Ali Alomari , Putra Sumari , Alireza Taghizadeh, "Multimedia Applications for MANETs over Homogeneous and Heterogeneous Mobile Devices", European Journal of Scientific Research, 60 , No.4, 2011.
[11]. Mohit Kumar and Rashmi Mishra,"An Overview of MANET: History ,Challenges and Applications", Indian Journal of Computer Science and Engineering , 3, No. 1,Mar 2012.
[12]. Ram Ramanathan and Jason Redi, "A Brief Overview of Ad Hoc Networks: Challenges and Directions", IEEE Communications Magazine 50th Anniversary Commemorative, May 2002.
[13]. Kavita Taneja, R.B.Pate l, "An Overview of Mobile Ad hoc Networks: Challenges and Future", Proceedings of National Conference on Challenges and Opportunities in Information Technology, RIMT-IET March 2007.
[14]. B. Wu, J. Wu, E.B. Fernandez, M. Ilyas, and S. Mangliveras,"Secure and Efficient Key Management in Mobile Ad-hoc Networks", Journal of Network and Computer Applications", Elsevier B.V, 2005.
[15]. Ivan Howitt, Wayne Manges, Teja Kuruganti, Glenn Allgood, Jose Gutierrez, James M. Conrad,"Wireless Industrial Sensor Networks:Framework for QoS Assessment and QoS Management," Transactions of the Instrumentation, Systems, and Automation Society , July 2006.
[16]. S. Tapaswi , Ramesh Joshi, "Environment Monitoring using wireless Sensor Networks", In Proceeding of National Conference on Issues and Trends in Wireless, December 2004.
[17]. David Oliver Jorg, "Performance Comparison Of MANET Routing Protocols In Different Network Sizes", IEEE Network, December 2001.
[18]. A. H. A. Rahman and Z. A. Zukarnain, "Performance comparison of AODV, DSDV and I-DSDV Routing Protocols in Mobile Ad Hoc Networks", European Journal of Scientific Research, 31, No.4, 2009.
[19]. Amandeep, Gurmeet Kaur,"Performance Analysis Of Aodv Routing Protocol In Mobile Ad Hoc Networks,International Journal of Engineering Science and Technology , 4, No.08 August 2012.
[20]. Gianni A. Di Caro, Frederick Ducatelle, Luca M. Gambardella,"A simulation study of routing performance in realistic urban scenarios for MANETs", In Proceedings of ANTS 2008, 6th International Workshop on Ant Algorithms and Swarm Intelligence, Brussels, Springer, LNCS 5217, 2008 .
[21]. Dr. P.K.Suri, Dr. M.K.Soni, Parul Tomar,"Framework for Location Based Power Aware Routing in Mobile Ad Hoc Networks", International Journal of Computer Science , 8, Issue 3, May 2011.
[22]. Shruti Sangwan, Ajay Jangra and Nitin Goel, "Vulnerabilities and Solutions: Mobile Ad Hoc Networks (Manets) For Optimal Routing and Security", Journal of Global Research in Computer Science, 2, No. 5, May 2011.
[23]. Parul Tomar , Vishal Saini," Efficient Routing Protocol for MANET", International Journal of Computer Networks and Wireless Communications, 2, No4, August 2012.
[24]. Neerja Khatri Arvind Kumar, "Analysing Performance of AODV in MANET: A SURVEY", International Journal of Scientific and Engineering Research, 3, Issue 6, June 2012.
[25]. Gergely V. Záruba, Vamsi K. Chaluvadi, and Azeem M. Suleman, "LABAR: Location Area Based Ad Hoc Routing for GPS-Scarce Wide-Area Ad Hoc Networks", Proceedings of the First IEEE International Conference on Pervasive Computing and Communications, 2003.
[26]. Hiroaki Higaki, "ABLA: Angle-Based Location Advertisement for Location-Based Ad-Hoc Routing Protocols", 5th international conference on new Technology, Mobility, Security, 2012.
[27]. Nen-Chung Wang and Si-Ming Wang, "An Efficient Location-Aided Routing Protocol for Mobile Ad Hoc Networks", IEEE International Conference on Parallel and Distributed system, 1,July 2005.
[28]. Seetha.R , Dr.R.Saravanan ," A Survey on Network Layer Multicast Routing Protocols for Mobile Ad Hoc Networks", IOSR Journal of Computer Engineering, 6,Issue 6,November-December 2012.
[29]. Saloni Singla , Tripatjot Singh Panag , "Evaluating The Performance Of Manet Routing Protocols", International Journal of Electronics and Communication Engineering and Technology, 4, No. 1, Ferbraury 2013.
[30]. Morteza Maleki , Karthik dantu , Massoud Pedram , "Power aware Source Routing Protocol for Mobile Ad-hoc Networks", International Symposium on Low Power Electronics and Design, 59, No.11, August 2002.
[31]. G. Varaprased, "New Power Aware Routing Algorithm for Mobile Ad-hoc Networks using Gateway Node", IEEE International Conference on Parallel and Distributed System, 2, December 5-7 2007.
[32]. Surya Kant, Dr.Krishan Kumar," Performance Analysis Of Dynamic Source Routing Protocol In Wireless Mobile Ad Hoc Network", International Journal of Engineering Research & Technology , 1, Issue 10, December 2012.
[33]. Gaurav Sharma, Vaishali Sahu, Prashant Kumar Maurya, Mahendra Srivastava, Ashish Allen Robert," International Journal of Engineering Research and Applications", 2, Issue 3, May-Jun 2012.
[34]. Vi. D. Park and M.S. Corson," A Performance Comparsion of the Temporally-Ordered Routing Algorithm and Ideal Link-State Routing". In Proceeding of the IEEE Symposium on Computers and Communication, June

[35]. Dube R, Rais CD, Wang K-Y, Tripathi SK, "Signal Stability-Based Adaptive Routing (SSA) for Ad Hoc Mobile Networks. IEEEPersonal Communications, Volume 4, Issue 1,1997
[36]. C. Perkins, E. B. Royer, S. Das, "Ad hoc On-Demand Distance Vector (AODV) Routing - Internet Draft", RFC 3561, IETF Network Working Group, July 2003.
[37]. J.J. Garcia-Luna-Aceves and E.L. Madruga, "The Core-Assisted Mesh Protocol" ,The IEEE Journal on Selected Area in Communication,17, No.8, August 1999.
[38]. C.C.Chiang, M.Gerla, and L.Zhang, "Forwarding Group Multicasting Protocol for Multi-Hop, Mobile Wireless Networks",ACM/Baltzer Journal of Cluster computing:Special Issue on Mobile Computing, 1, No.2,1998.
[39]. A. Udaya Shankar, Simon S. Lam ," An HDLC protocol specification and its verification using image protocols", ACM Transactions on Computer Systems , 1,Issue 4,1983.
[40]. Ross, F.E., "Fiber distributed data interface: an overview ", Proceeding of 15th IEEE conference on Local Computer Network, October 1990.
[41]. Ka-Cheong, "Transmission control protocol (TCP) in wireless networks: issues, approaches, and challenges", IEEE Magazine of communication survey, 8, Issue 4, 2006.
[42]. D.Marlow, "Host Group Extensions for CLNP Multicasting", RFC Editor, 1995.
[43]. J¨org Sommer ,Sebastian Gunreben ,Frank Feller, Martin K¨ohn , Detlef Sab, Joachim Scharf, Ahlem Mifdaoui," Ethernet – A Survey on its Fields of Application", Open Archive Toulouse Archive Ouverte , 2010, 12 No.2, 2010.
[44]. "Link layer discovery Protocol: A New Standard for Discovering and Managing Converged Network Devices", Extreme network, 2006.
[45]. C. Perkins, P. Bhagwat, "Highly dynamic destination-sequenced distance-vector routing (DSDV) for Mobile Computers," ACM SIGCOMM, October 1994.
[46]. Lee, "Neighbor supporting ad hoc multicast routing protocol", IEEE conference on mobile ad-hoc networking and computing, 2000.
[47]. Subir Kumar Das, B. S. Manoj, C. Siva Ram Murthy,"A Dynamic Core Based Multicast Routing Protocol for Ad hoc Wireless Networks" ,ACM ,June 2002.
[48]. David H. Ahl, "Cooperative Computing", National Computer Conference, 9, NO. 8, May 1983.
[49]. Cricket Liu, Paul Albitz, "DNS and BIND", O'Reilly Media, 5th Edition, May 2006.
[50]. Saurabh Ganeriwal,Ram Kumar , Mani B. Srivastava ,"Timing-sync protocol for sensor networks" , ACM Proceedings of the Ist international conference on Embedded network sensor systems,2003.
[51]. Balabanian , Casey, Greene, Adams, "An introduction to digital storage media command and control", IEEE journal and magazine , 34 , Issue 11,1996.
[52]. Yegenoglu, F. George Mason Univ., Fairfax, VA, USA Jabbari, B., "Transaction capabilities application part nd intelligent network services" IEEE conference on communication, 2 June 1992.
[53]. Fredrik Davik , Mete Yilmaz , Stein Gjessing , Necdet Uzun ,"IEEE 802.17 Resilient Packet Ring Tutorials", IEEE Communication magazine ,July 2003.
[54]. Sollins , K., "The TFTP Protocol (Revision 2)", STD 33, RFC 1350, July 1992.
[55]. Jon Postel, "File Transfer Protocol", RFC 765, NIC, June, 1980.
[56]. Jon Postel, "User Datagram Protocol", RFC 768, NIC, August, 1980.
[57]. Mrs. B.D. Shirodkar ,Dr.S.S.Manvi , .J.Umbarkar, "Multicast Routing for Mobile Ad-Hoc Networks using Swarm Intelligence", International Journal of Recent Trends in Engineering, 1, No. 1, May 2009.
[58]. J. Slein ,F. Vitali, E. Whitehead ,D. Durand ," Requirements for a Distributed Authoring and Versioning Protocol for the World Wide Web" ,RFC Editor,1998.
[59]. Horgas , J. and R. Morgans ,"Lightweight Directory Access Protocol :Technical specification" ,RFC 3377,September 2002.
[60]. Chen, Po. Data communication, "How to make the most of ISDN's new LAPD protocol", McGraw-Hill, August 1987.
[61]. Philip K. McKinley, Member, IEEE, Chiping Tang, and Arun P. Mani ,"A Study of Adaptive Forward Error Correction for Wireless Collaborative Computing", IEEE Transactions on Parallel and Distributed Systems , 13, No. 9, September 2002.
[62]. Allen Doug,"IPX protocol suit".
[63]. Chapter: 3, "The Networker's Guide to AppleTalk, IPX, and NetBIOS".
[64]. S. Kent, "IP Encapsulating Security Payload", Request for Comments: 2406", BBN Corp, 1827 .
[65]. San Jose, "Cisco Application Networking for Siebel 8.0 Solutions Deployment Guide", America Headquater Cisco Systems, Inc. 170 West Tasman Drive.
[66]. Spirant Communicatio, "Link Aggregation Control Protocol (IEEE 802.3AD) Base Package".
[67]. Biju Issac, "Secure ARP and Secure DHCP Protocols to Mitigate Security Attacks", International Journal of Network Security, 8, No.2, March 2009.
[68]. Postel, J., "Telnet Protocol Specification", RFC 764, USC/Information Sciences Institute, June 1980.
[69]. Chapter: 5, "Basic ISUP Signaling",ISUP and TCAP.
[70]. Boukerche,Kaiyuan Lu ," Optimized dynamic grid-based DDM protocol for large-scale distributed simulation systems" ,19th International conference on Parallel and Distributed Processing Symposium,April 2005.
[71]. Natarajan Meghanathan , "Survey of Topology-based Multicast Routing Protocols for Mobile Ad hoc Networks ", International Journal of Communication Networks and Information Security 3, No. 2, August 2011.
[72]. "Apple Filing Protocol Programming Guide": E-book.
[73]. Ozaki, Jaime Bae Kim , Suda, T., "Bandwidth-efficient multicast routing protocol for ad-hoc networks", 8th IEEE International Conference on Computer Communication and Networking, October 1999.
[74]. Sisodia ,R.S. Karthigeyan ,Manoj , B.S., Murthy, C.S.R ," A preferred link based multicast protocol for wireless mobile ad hoc networks" ,IEEE International Conference on Communication, May2003.
[75]. Ghassemian , M. Friderikos, V., Aghvami, H.," Performance analysis of Internet gateway discovery protocols in ad hoc networks", IEEE Conference of Wireless Communication and Networking ,March 2004.
[76]. Das, S.K. Manoj, B.S., Murthy, C.S.R.,"Weight based multicast routing protocol for ad hoc wireless networks", IEEE Conference on Global Telecommunication , 1 November 2002.

[77]. Jan A. Audestad, "The Mobile Application Part (MAP) of GSM", the Consultative Committee on International Telephony and Telegraphy of the International Telecommunications Union, March 2003.
[78]. Javvin Technology, "Network Protocols Handbook: Overview of All Active Network Protocols".
[79]. Chapter 23, "The Information about VLAN", Cisco IOS Software Configuration Guide, Release 15.0SY.
[80]. Evan Kingston, "BACnet", Honeywell Automation and Control Systems, July 2012.
[81]. Chapter: 19, "UNIX System Administration Handbook",SLIP and PPP.
[82]. Gee-Swee Poo, Boon-Ping Chai ," ISO FTAM protocol performance",Elesvier Computer Communication, Vol.4,Issue 7,September 1991.
[83]. Chapter:13 ,"Internet Relay Chat" ,Major Players of IRC,Securing Im and P2P Applications for the Enterprise, 2005.
[84]. Sherif,M.H. ,Krishna kumar A.S."Evaluation of", IEEE Conference on Global Telecommunication, 2, 1990.
[85]. Tasaka,S. , Suzuki,T.INFOCOM, "A performance comparison of connection-oriented and connectionless LLC protocols in a high-speed satellite data network", 10th IEEE Conference on Computer and Communication Societies, 2.1991.
[86]. Y.J.Cho, "Discrete-time analysis of throughput and response time for LAP derivative protocols under Markovian block-error pattern", Computer Communication, 22, Issue 5, April 1999.
[87]. ARCnet Designer's Handbook, Document 61610, Datapoint Corporation, 1983.
[88]. Joseph M. Soricelli ,John L. Hammond, Galina Diker Pildush,Thomas E. Van Meter, and Todd M. Warble, Chapter :7 ," Juniper™ Networks Certified Internet Associate", Intermediate system to system,2003.
[89]. William Stalling, "Protocol Basics: Secure Shell Protocol", Journal on Internet Protocol, Vol.12, No.4.
[90]. Chiang, R.C.N. , Sesmun, A. Foster, G., Young, M., Baker, N., "Transport of mobile application part signaling over Internet protocol" , IEEE journal and magazine,Vol.40 ,Issue 5,May 2002.
[91]. Tauj Khurana, Sukhvir Singh, Nitin Goyal. "An Evaluation of Ad-hoc Routing Protocols for Wireless Sensor Networks." International Journal of Advanced Research in Electronics and Communication Engineering, Vol. 1, No. 1, July 2012.