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Review Study of Routing Protocols and Versatile Challenges of MANET

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***Abstract*— MANET is collection of mobile devices form a self-creating, self-organizing and self-administering wireless networks. Or MANET is the collection of multi-hops mobiles (wireless) nodes. These are communicate with each other without any centralized control or established infrastructure. Infrastructure less environment and frequently changing topology are used. As wireless links are highly error prone and can be do down frequently due to mobility of nodes. So the stable routing is very critical task due to the infrastructure less environment in MANET. In this paper, provide an overview list of all routing protocols and also study of challenges and technology of MANET routing protocols-optimized link state routing (OLSR), destination sequence distance vector (DSDV), dynamic source routing (DSR), ad-hoc on demand distance vector routing (AODV) and temporary ordered routing protocol (TORA). Also discuss history, characteristics and applications of MANET.**

***Index Terms*—History, Routing Protocols(OLSR, DSDV, DSR, AODV, TORA), Characteristics, Challenges, Applications, Technology.**

I. INTRODUCTION

THE wireless network is a network without any physical Connection or cables. The wireless networks can be classified into two types: INFRASTRUCTURED and INFRASTRUTURELESS. In infrastructure wireless networks the mobiles can be move while communication and its base station are fixed. If the node or mobile goes out of the range of base station, it gets into the range of another base station. But in the infrastructure less networks are no any fixed base station and all nodes in network act as routers. MANET is the collection of wireless mobile nodes forming a temporary or short lived network without any base station. MANETs have several salient characteristics:

- Dynamic topologies
- Bandwidth-constrained
- Variable capacity links
- Energy-constrained operation
- Limited physical security

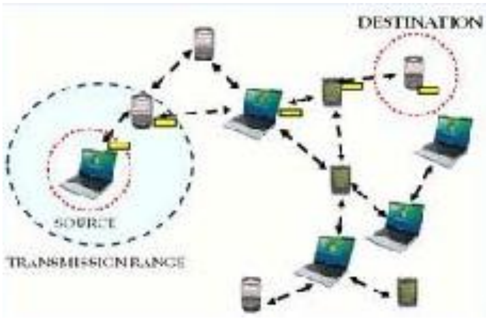

Fig.1-wireless networks

II. HISTORY OF MANET

Infrastructure wireless networks each use directly Communicates with an access point of Base station but Infrastructure less networks are does not communicate the find base station. It is work autonomous independent in the network MANET mobile nodes are responsible for dynamically discovering each other. In order to enable communication between nodes that are notes directly with in each other's send rang, intermediate nodes act as routers that relay packets generated by other node to the destination. Devices are free to join or leave the networks and they may move randomly, possible resulting in rapid and unpredictable topology changes. In this energy constrained, dynamic, distributed multi-hope environment, nodes need to organize themselves dynamically Submit your manuscript electronically for review.

Fig.2-cellular network

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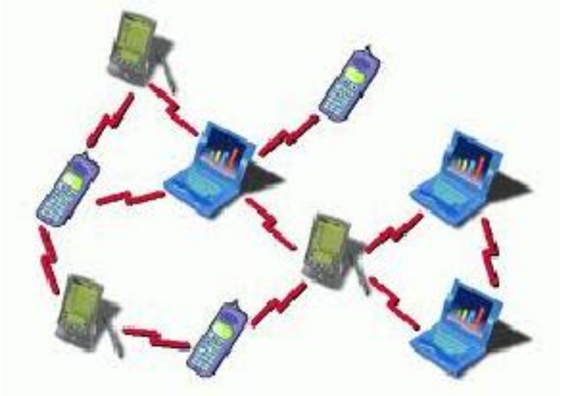

Fig.3-mobile ad-hoc network

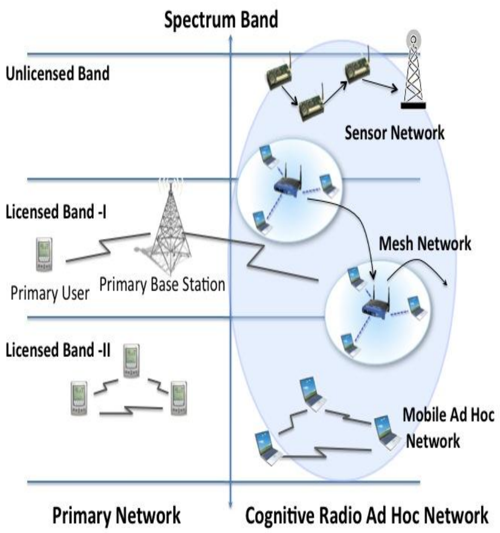

Fig.4-spectrum of MANET

III. LIST OF AD HOC ROUTING PROTOCOLS

A. Pro-active (table-driven) routing

This type of protocols maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network. The main disadvantages of such algorithms are:

A. Respective amount of data for maintenance.
B. Slow reaction on restructuring and failures.

Examples of pro-active algorithms are:

- Babel, a protocol inspired by DSDV with faster Convergence and ETX link quality estimation. Free Implementation available.
- B.A.T.M.A.N.-Better approach to mobile ad- hoc Networking.
- CGSR(Cluster head Gateway Switch Routing protocol)
- DFR (“Direction” Forward Routing)
- DBF (Distributed Bellman-Ford Routing Protocol)
- DSDV(Highly Dynamic Destination-Sequenced Distance Vector routing protocol)
- HSR (Hierarchical State Routing protocol)
- IARP (Intra zone Routing Protocol/pro-active part of the ZRP).
- LCA (Linked Cluster Architecture)
- MMRP (Mobile Mesh Routing Protocol)
- WAR (Witness Aided Routing)
- OLSR (Optimized Link State Routing Protocol).

B. Reactive (on-demand) routing

This type of protocols finds a route on demand by flooding the network with Route Request packets. The main disadvantages of such algorithms are:

1. High latency time in route finding.
2. Excessive flooding can lead to network clogging.

Examples of reactive algorithms are:

- SENCAST
- Reliable Ad hoc On-demand Distance Vector
- Routing Protocol
- Ant-based Routing Algorithm for Mobile Ad hoc Networks
- Admission Control enabled On demand Routing(ACOR)
- Adriane
- Associability-Based Routing
- Ad hoc On-demand Distance Vector(AODV)
- Ad hoc On-demand Multipath Distance Vector
- Backup Source Routing
- Dynamic Source Routing
- Flow State in the Dynamic Source Routing
- Dynamic Nix-Vector Routing
- Dynamic MANET on-demand Routing

C. Flow oriented routing

This type of protocols finds a route on demand by following Present flows. One option is to uncast consecutively when Forwarding data while promoting a new link. The main Disadvantages of such algorithms are:

1. Takes long time when exploring new routes without a prior knowledge.
2. May refer to imitative existing traffic to compensate for missing knowledge on routes.

Examples of flow oriented algorithms are:

- GB (Gaffney Bertsimas)
- IERP (Inter-zone Routing Protocol/reactive part of
- the ZRP)
- LUNAR (Lightweight Underlay Network Ad hoc
- Routing)
- RDMAR (Relative-Distance Micro-discovery Ad hoc
- Routing protocol)
- SSR (Signal Stability Routing protocol)

D. Hybrid (both pro-active and reactive) routing

This type of protocols combines the advantages of proactive and of reactive routing. The routing is initially established with some proactively prospected routes and then serves the demand from additionally activated nodes through reactive flooding. The choice for one or the other method requires predetermination for typical cases.

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The main disadvantages of such algorithms are:

1. Advantage depends on number of nodes activated.
2. Reaction to traffic demand depends on gradient of Traffic volume.

Examples of hybrid algorithms are:

- HRPLS (Hybrid Routing Protocol for Large Scale Mobile Ad Hoc Networks with Mobile Backbones)
- HWMP (Hybrid Wireless Mesh Protocol)
- ZRP (Zone Routing Protocol)

E. Hierarchical routing protocols

With this type of protocols the choice of proactive and of reactive routing depends on the hierarchic level where a node resides. The routing is initially established with some proactively prospected routes and then ser from additionally activated nodes through reactive flooding on the lower levels. The choice for one or the other method requires proper attribution for respective levels.

The main disadvantages of such algorithms are:

1. Advantage depends on depth of nesting and addressing scheme.
2. Reaction to traffic demand depends on meshing parameters.

Examples of hierarchical routing algorithms are:

- CBRP (Cluster Based Routing Protocol)
- CEDAR (Core Extraction Distributed Ad hoc Routing)
- FSR (Fisheye State Routing protocol)
- GSR (Global State Routing protocol)

F. Backpressure Routing

This type of routing does not pre-compute paths. It chooses next-hops dynamically as a packet is in progress toward its destination. These decisions are based on congestion gradients of neighbor nodes. When this type of routing is used together with max-weight link scheduling, the algorithm is throughput optimal. See further discussion here: Backpressure Routing.

G. Host Specific Routing protocols

This type of protocols requires thorough administration to tailor the routing to a certain network layout and a distinct flow strategy. The main disadvantages of such algorithms are:

1. Advantage depends on quality of administration Addressing scheme.
2. Proper reaction to changes in topology demands Reconsidering all parameterize.

H. Power-aware routing protocols

Energy required to transmit a signal is approximately proportional to d^α, where d is the distance and α>=2 is the attenuation factor or path loss exponent transmission medium. When α = 2 (which is the optimal case), transmitting a signal half the distance requires one fourth of the energy and if there is a node in the middle willing to spend another fourth of its energy for the second half, data would be transmitted for half of the energy than through a direct transmission - a fact that follows directly from the square law of physics.

The main disadvantages of such algorithms are:

1. This method induces a delay for each transmission.
2. No relevance for energy network powered Transmission operated via sufficient repeater Infrastructure.

I. Multicast routing

- MRMP (Maximum-Residual Multicast Protocol)
- Era Mobile (Epidemic Multicast
- PUMA (Protocol for Unified Multicasting Through
- Announcements)
- AMRIS (Ad hoc Multicast Routing protocol utilizing
- Increasing id-numbers).

J. Geographical multicast protocols (GEO Casting)

- Geo TORA (Geographical TORA (see TORA)
- MOBICAST (Mobile Just-in-time Multicasting)
- Abiding Geo cast / Stored Geo cast (Time Stable Geo casting).

K. Other protocol classes

- INSIGNIA (In-band signaling support for QOS in Mobile Ad hoc Networks)
- IMEP (Internet MANET Encapsulation Protocol)
- ANMP (Ad-hoc Network management protocol
- Term node Routing which is a combination of two routing methods namely Term ode local routing and Term node Remote Routing
- W2LAN (Wireless to LAN Protocol)
- Opportunity Driven Multiple Access (ODMA) Epsilon option of the 3GPP standard.

IV. SOME ROUTING PROTOCOLS

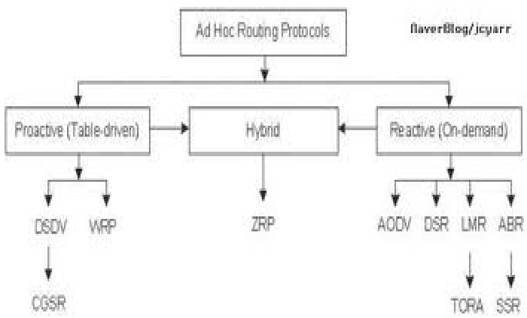

Fig.4-diagram of Some Protocols

A. OLSR (Optimized link state routing)

The Optimized Link State Routing Protocol (OLSR) is an IP routing protocol optimized for mobile ad-hoc networks, which can also be used on other wireless ad-hoc networks. OLSR is a proactive link, which uses Hello and Topology Control (TC) messages to discover and then disseminate link state information throughout the mobile ad-hoc network. Individual nodes use this topology information to compute next hop destinations for all nodes in the network using shortest hop forwarding paths Using Hello messages the OLSR protocol at each node discovers 2-hop neighbor information and performs a distributed election of a set of multipoint relays (MPRs).

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Nodes select MPRs such that there exists a path to each of its 2-hop neighbors via a node selected as an MPR. These MPR nodes then source and forward TC messages that contain the MPR selectors.

This functioning of MPRs makes OLSR unique from other link state routing protocols in a few different ways: The forwarding path for TC messages is not shared among all nodes but varies depending on the source, only a subset of nodes source link state information, not all links of a node are advertised but only those that represent MPR selections. Since link-state routing requires the topology database to be synchronized across the network, OSPF and ISIS perform topology flooding using a reliable algorithm. Such an algorithm is very difficult to design for ad-hoc wireless networks, so OLSR doesn't bother with reliability; it simply floods topology data often enough to make sure that the database does not remain unsynchronized for extended periods of time, a proactive protocol, routes to all destinations within the network are known and maintained before use. Having the routes available within the standard routing table can be useful for some systems and network applications as there is no route discovery delay associated with finding a new route.

Default and network routes can be injected into the system by HNA messages allowing for connection to the internet or other networks within the OLSR MANET cloud. Network routes are something reactive protocols do not currently execute well. Timeout values and validity information is contained within the messages conveying information allowing for differing timer values to be used at differing nodes. OLSR makes use of "Hello" messages to find its one hop neighbors and its two hop neighbors through their responses. The sender can then select its multipoint relays (MPR) based on the one hop node that offers the best routes to the two hop nodes. Each node has also an MPR selector set, which enumerates nodes that have selected it as an MPR node.

LSR uses Topology Control (TC) messages along with MPR forwarding to disseminate neighbor information throughout the network. Host and Network Association (HNA) messages are used by OLSR to disseminate network route advertisements in the same way TC messages advertise host routes.

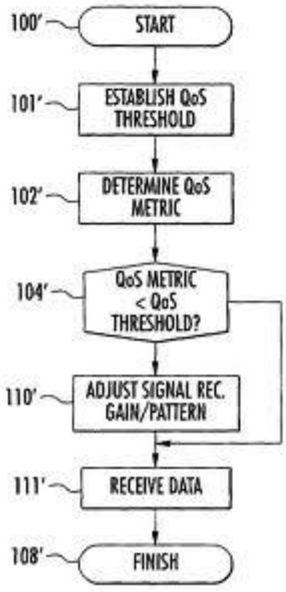

Fig.5- Working steps diagram of OLSR

B. *DSDV (Destination Sequence Distance Vector)*

The Destination Sequence Distance Vector is a well known MANET routing protocol. It comes under proactive or table driven routing protocol. It is based on Bellman-Ford routing mechanism. Actually, it is the improved form of Bellman-Ford routing mechanism. Every node in this maintains a routing table which contains list of all known destination node within the network along with number of hops required to reach a particular node. In DSDV each table must contain the destination node address, the minimum number of hops to that destination, the next hop in the direction of that destination and an entry for sequence numbers for every destination. A higher sequence number denotes a more recent update sent out by the source node.

DSDV at first determines the topology information and the route information by exchanging these routing tables, which each node maintains. Exchanging of routing updates are done whenever a node detects a change in topology. When a node receives any update information, it first check the sequence number in the packet and if the information in the packet is older than the receiving node has in its routing tables, then the packet is rejected otherwise the information is updated approximately in the receiving node’ s routing table. After this the update packet is forwarded to all other neighboring nodes except the one from which the packet came. The update made may be full update or a partial update. In full update, the complete routing table is sent out and in case of a partial update only the changes since last update are sent out.

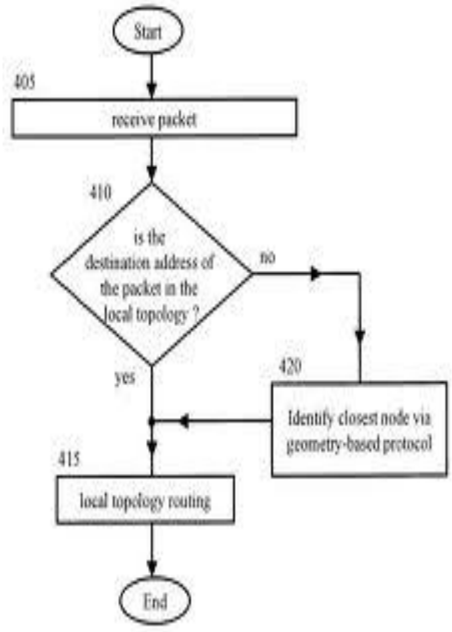

Fig.6- ER-Diagram of DSDV

C. DSR (Dynamic source Routing)

The Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self-organizing and self configuring, without the need for any existing network infrastructure or administration.DSR has been implemented by numerous groups, and deployed on several test beds. Networks using the DSR protocol have been connected to the Internet. DSR can interoperate with Mobile IP, and nodes using Mobile IP and DSR have seamlessly migrated between WLANs, cellular data services, and DSR mobile ad hoc networks. The protocol is composed of the two main mechanisms of "Route Discovery" and "Route Maintenance", which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network. All aspects of the protocol operate entirely on-demand, allowing the routing packet overhead of DSR to scale automatically to only that needed to react to changes in the routes currently in use.

The protocol allows multiple routes to any destination and allows each sender to select and control the routes used in routing its packets, for example for use in load balancing or for increased robustness. Other advantages of the DSR protocol include easily guaranteed loop-free routing, support for use in networks containing unidirectional links, use of only "soft state" in routing, and very rapid recovery when routes in the network change. The DSR protocol is designed mainly for mobile ad hoc networks of up to about two hundred nodes, and is designed to work well with even very high rates of mobility.

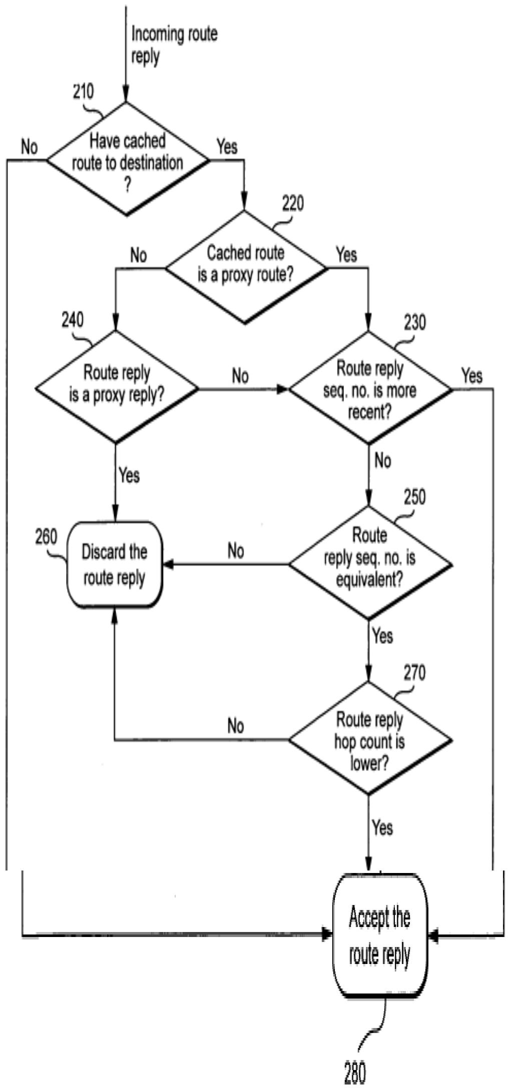

Fig.7: ER-Diagram of DSR

D. *AODV (Ad-hoc On Demand Distance Vector Routing)*

In November 2001 the MANET (Mobile Ad-hoc Networks) Working Group for routing of the IEFT community has published the first version of the AODV Routing Protocol (Ad hoc On Demand Distance Vector).AODV belongs to the class of Distance Vector Routing Protocols (DV). In a DV every node knows its neighbors and the costs to reach them. A node maintains its own routing table, storing all nodes in the network, the distance and the next hop to them. If a node is not reachable the distance to it is set to infinity. Every node sends its neighbors periodically its whole routing table. So they can check if there is a useful route to another node using this neighbor as next hop. When a link breaks a Count-To-Infinity could happen. AODV is an 'on demand routing protocol' with small delay. That means that routes are only established when needed to reduce traffic overhead. AODV supports unicast, Broadcast & Multicast without any further protocols.

The Count-To-Infinity and loop problem is solved with sequence numbers and the registration of the costs. In AODV every hop has the constant cost of one. The routes age very quickly in order to accommodate the movement of the mobile nodes. Link breakages can locally be repaired very efficiently. To characterize the AODV with the five criteria used by Kershaw AODV is distributed, hop-by-hop, deterministic, single path and state dependent. AODV uses IP in a special way. It treats an IP address just as a unique identifier. This can easily be done with setting the Subnet mask to 255.255.255.255. But also aggregated networks are supported. They are implemented as subnets. Only one router in each of them is responsible to operate the AODV for the whole subnet and serves as a default gateway. It has to maintain a sequence number for the whole subnet and to forward every package. In AODV the routing table is expanded by a sequence number to every destination and by time to live for every entry. It is also expanded by routing flags, the interface, a list of precursors and for outdated routes the last hop count is stored. Security is a very dangerous point in mobile communication. AODV defines no special security mechanisms. So an impersonation attack can easily be done. In order to prevent this authentication is required for example with PKA (public key authentication). Messages can easily be intercepted. In order to prevent this you can cipher them for example with a PK (public key). Standard IP security protocols like IPSec should not be used.

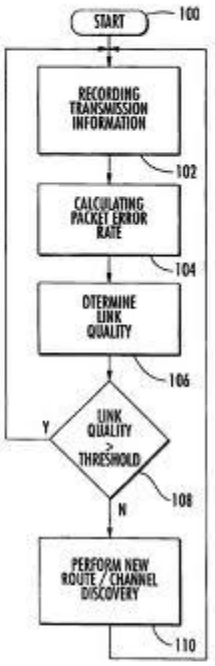

Fig.8- working steps diagram on AODV

E. TORA (Temporary Ordered Routing Protocol)

The Temporally-Ordered Routing Algorithm (TORA) is an algorithm for routing data across Wireless Mesh Networks or Mobile ad-hoc networks. It was developed by Vincent Park at the University of Maryland and the Naval Research Laboratory. Park has patented his work, and it was licensed by Nova Engineering, who is marketing a wireless router product based on Parks algorithm. The TORA attempts to achieve a high degree of scalability using a "flat", non-hierarchical routing algorithm. In its operation the algorithm attempts to suppress, to the greatest extent possible, the generation of far-reaching control message propagation. In order to achieve this, the TORA does not use a shortest path solution, an approach which is unusual for routing algorithms of this type. TORA builds and maintains a Directed Acyclic Graph rooted at a destination. No two nodes may have the same height. Information may flow from nodes with higher heights to nodes with lower heights. Information can therefore be thought of as a fluid that may only flow downhill. By maintaining a set of totally-ordered heights at all times, TORA achieves loop-free multipath routing, as information cannot 'flow uphill' and so cross back on itself. The key design concept of TORA is localization of control messages to a very small set of nodes near the occurrence of a topological change. To accomplish this, nodes need to maintain the routing information about adjacent (one hop) nodes. The protocol performs three basic functions:

- Route creation
- Route maintenance
- Route erasure

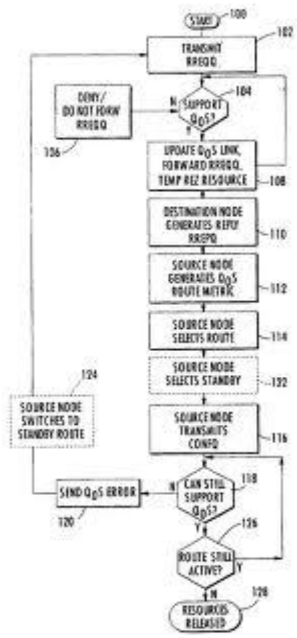

Fig.9-working steps diagram of TORA

V. CHARACTERISTICS AND CHALLENGES IN MANET

The specific characteristic and complexities impose many design challenges to the network protocol. These networks are faced with the traditional problems inherent to wireless communication such as lower reliability than wire media, limited physical security, time varying channels, interference etc. the many design constraints, mobile ad-hoc network offer numerous advantages.

Some of the challenges in MANET are:

a) Multi-hop and stable routing.
b) Autonomous and infrastructure less.
c) Infrastructure less topology.
d) Low power or efficient routing.
e) Self-creation, self-organization and self administration.
f) Network scalability.
g) Fast communication speed in dynamic hosts.
h) Quality of service.
i) Security of network and routing.
j) Uni-directional links.
k) Constrained resources.
l) Network partitions.

VI. TECHNOLOGICAL CHALLENGES

The specific characteristics of MANET impose many challenges to network protocol design on all layers of the protocol stack. The physical layer must deal with rapid changes in link characteristics. The media access control (MAC) layer needs to allow fair channel access, minimize packet collision and deal with hidden and exposed terminals. At the network layer, nodes need to corporate to calculate paths. The transport layer must be capable for handling packet loss and delay characteristic that are very difficult from wired networks. Application should be able to handle possible disconnections and reconnections. Furthermore all network protocol development need to integrate smoothly with all traditional networks and take into account possible security problems. The traditional challenges and possible solutions are-

- Unicast Routing.
- Service and resource discovery.
- Addressing and internet connectivity.
- Security and node cooperation

VII. APPLICATIONS AND POSSIBLE SCENARIOS/SERVICES

Tactical networks

- Military communication and operations
- Automated battlefields

Emergency services

- Search and rescue operations
- Disaster recovery
- Replacement of fixed infrastructure in case of environmental disasters
- Policing and fire fighting
- Supporting doctors and nurses in hospitals

Commercial and civilian environments

- E-commerce: electronic payments anytime and anywhere
- Business: dynamic database access, mobile offices
- Vehicular services: road or accident guidance, transmission of road and weather conditions, taxi cab network, inter vehicle networks
- Sports stadiums, trade fairs, shopping malls
- Networks of visitors at airports

Home and enterprise networking

- Home/office wireless networking
- Conferences, meeting rooms
- Personal area networks (PAN), Personal networks (PN)
- Networks at construction sites

Education

- Universities and campus settings
- Virtual classrooms
- Ad-hoc communications during meetings or lectures

Entertainment

- Multi-user games
- Wireless P2P networking
- Outdoor Internet access
- Robotic pets
- Theme parks

Sensor networks

- Home applications: smart sensors and actuators

Embedded in consumer electronics

- Body area networks (BAN)
  - Data tracking of environmental conditions, animal movements, chemical/biological detection

Context aware services

- Follow-on services: call-forwarding, mobile workspace
- Information services: location specific services, time dependent services
- Infotainment: touristic information

Coverage extension

- Extending cellular network access
- Linking up with the Internet, intranets, etc.

VIII. CONCLUSION

In this research paper, an effort has been made to concentrate on the overview study of all routing protocols and also discuss about behavioral study and performance analysis of various prominent routing protocols viz. OLSR, DSDV, DSR, AODV, and TORA with the working diagrams. It has been further concluded that due to the dynamically Changing topology and infrastructure less, decentralized Characteristics, security and power awareness is hard to achieve in mobile ad hoc networks and a technological point of view, the realization of this vision still requires a large number of Challenges to be solved related to devices, Protocols, applications and services. The focus of the study is on these issues in our future research work and effort will be made to propose a solution for routing in Ad-hoc networks by tackling these core issues of secure and power aware/energy efficient routing.

REFERENCES

[1] Jeroen Hoebeke, Ingrid Moerman, Bart Dhoedt and Piet Demeester-An Overview of Mobile Ad Hoc Networks: Applications and Challenges.

[2] Sunil Taneja*and Ashwani Kush, "International Journal of Innovation, Management and Technology", Vol. 1, No. 3, August 2010 ISSN: 2010-0248-A Survey of Routing Protocols in Mobile Ad Hoc Networks.

[3] BY: rashmi | Category: Technology and Computers |PostDate:2008-08-11http://www.saching.com/Article/MANET---Mobile-Ad-hoc - Network--/334.

[4] Ashwani Kush, Phalguni Gupta, Ram Kumar, "Performance Comparison of Wireless Routing Protocols", Journal of CSI, Vol 35 No.2, April-June 2005.

[5] Anne Aaron, Jie Weng, "Performance Comparison of Ad-hoc Routing Protocols for Networks with Node Energy Constraints", available at http://ivms.stanford.edu

[6]IETF MANET Working Group. http://www.ietf.org/html.charters/manetcharter.Html

[7] Basagni, S., Conti, M., Giordano S., and Stojmenovic ,I.(Eds.) Ad Hoc Networking .IEEE Press Wiley, New York,2003

[8] List of ad hoc routing protocols From Wikipedia, the free encyclopedia.http://en.wikipedia.org/wiki/List_of_ad_hoc_routi ng_protocol s

[9]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_proto cols # Pro-active_.28table-driven.29_routing

[10]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_protocol s#Reactive_.28on-demand.29_routing

[11]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_protocol s#Flow-oriented_routing.

[12]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_protocol sHybrid_.28both_pro-active_and_reactive.29_routing

[13]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_protocol s#Hierarchical_routing_protocols

[14]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_protocol s#Backpressure_Routing

[15]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_protocol s#Host_Specific_Routing_protocols

[16]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_protocol s#Power-aware_routing_protocols

[17]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_ pr otocols#Multicast_routing

[18]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_ protocols#Geographical_multicast_protocols_.28.

[19]http://en.wikipedia.org/wiki/List_of_ad_hoc_routing_protocol s#Other_protocol_classes.

[20] Ankur Ketrapal Department of Computer Engineering, Delhi College of Engineering, Delhi University Routing techniques for Mobile Ad Hoc Networks Classification and Qualitative /Quantitative Analysis.