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A REVIEW OF DIFFERENT MULTICAST ROUTING PROTOCOL FOR MOBILE ADHOC NETWORK (MANET)

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***Abstract*— In this survey paper discuss the Mobile Ad-hoc NETwork (MANET). This paper discusses on different previous work presented by different researchers on multi path mobile ad-hoc network. Also discuss the different challenges face in mobile ad-hoc network deployment. Simulation of MANET is an important part of research work. In this environment, multicast routing protocols are faced with the challenge of producing multi-hop routing under host mobility and bandwidth constraint. Multicast routing plays a significant role in MANETs. In recent years, various multicast routing protocols with distinguishing feature have been newly proposed. In order to provide a comprehensive understanding of these multicast routing protocols designed for MANETs and pave the way for the further research, a survey of the multicast routing protocols is discussed in detail in this paper.**

Keywords—MANET, Multicast Routing Protocols, Simulation Analysis, and Matrix Laboratory

I. INTRODUCTION

Mobile ad hoc networks (MANETs) are application of wireless ad-hoc network. MANETs were first said and presented in 2001 under "auto to-auto specially appointed portable correspondence and systems administration" applications, where systems can be framed and data can be handed-off among autos. It was demonstrated that node-to-node and node-to-roadside interchanges designs will exist together in MANETs to give street security, route, and other roadside administrations. MANETs are a key piece of the astute transportation frameworks structure. Some of the time, MANETs are eluded as Smart Transportation Networks. By 2015, the term MANET ended up being generally synonymous with the more non particular term between node correspondence (IVC), notwithstanding the way that the consideration remains with respect to unconstrained frameworks organization, extensively less on the usage of structure like Street Side Units (RSUs) or cell frameworks.

The framework is offhand since it doesn't rely upon an earlier structure, for instance, switches in wired frameworks or entries in administered (establishment) remote systems. Or maybe, every center appreciates guiding by sending data for various centers, so the confirmation of which center points forward data is made dynamically in view of mastermind accessibility and the coordinating figuring being used. In the Windows working structure, off the cuff is a correspondence mode (setting) that empowers PCs to direct talk with each other without a switch.

Dynamic frameworks in which centers are permitted to move. Remote frameworks don't have the complexities of establishment setup and association, enabling devices to make and join frameworks "on the fly" – wherever.

Astute Mobile specially appointed systems utilize Wi-Fi IEEE 802.11p (WAVE standard) and WiMAX IEEE 802.16 for simple and viable correspondence between vehicles with dynamic versatility.

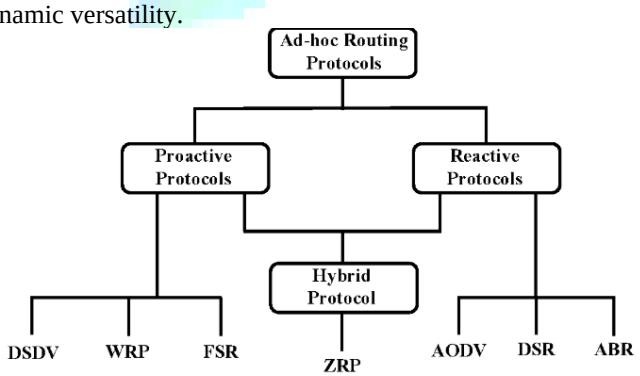

Figure 1: Types of protocol

Powerful measures, for example, media correspondence between vehicles can be empowered also strategies to track car vehicles. In MANET isn't predicted to supplant current versatile (wireless) correspondence principles.

"More seasoned" plans inside the IEEE 802.11 extension may allude just to IEEE 802.11b/g. Later outlines allude to the most recent issues of IEEE 802.11p (WAVE, draft status). Because of natural slack circumstances, just the last one in the IEEE 802.11 extension is equipped for adapting to the run of the mill flow of node activity.

Car Mobile data can be seen on electronic maps utilizing the Web or concentrated programming. The upside of Wi-Fi based route framework work is that it can successfully find a node which is inside huge grounds like colleges, air terminals, and passages. In MANET can be utilized as a major aspect of car gadgets, which needs to distinguish an ideally negligible way for route with insignificant activity power. The framework can likewise be utilized as a city manual for find and recognize milestones in another city.

Correspondence abilities in vehicles are the premise of an imagined In MANET or canny transportation frameworks (ITS). Vehicles are empowered to impart among themselves (node-to-vehicle, N2N) and by means of roadside passageways (node-to-roadside, N2R) additionally called as Street Side Units (RSUs). Mobile correspondence is relied upon to add to more secure and more effective streets by giving opportune data to drivers, and furthermore to make travel more helpful. The reconciliation of N2N and N2R correspondence is useful in light of the fact that N2R gives better administration inadequate systems and long separation correspondence, while N2N empowers guide correspondence for little to medium separations/zones and at areas where roadside passageways are not accessible.

Giving node- node and node- roadside correspondence can significantly enhance activity wellbeing and solace of driving and voyaging. For correspondence in Mobile impromptu systems, position-based steering has risen as a promising applicant. For Web get to, Portable IPv6 is a broadly acknowledged answer for give session progression and reachability to the Web for versatile hubs. While incorporated answers for utilization of Portable IPv6 in (non-vehicular) versatile impromptu systems exist, an answer has been recommended that, based upon a Versatile IPv6 intermediary based engineering, chooses the ideal correspondence mode and gives dynamic exchanging between node- node and node-roadside correspondence mode amid a correspondence session in the event that that in excess of one correspondence mode is at the same time accessible.

MANETs bolster an extensive variety of uses – from straightforward one jump data spread of, e.g., agreeable mindfulness messages (CAMs) to multi-bounce scattering of messages over tremendous separations. A large portion of the worries important to versatile specially appointed systems (MANETs) are of enthusiasm for VANETs, however the subtle elements differ. As opposed to moving aimlessly, vehicles tend to move in a sorted out manner. The cooperations with roadside gear can in like manner be portrayed reasonably precisely. Lastly, most vehicles are limited in their scope of movement, for instance by being obliged to take after a cleared thruway.

B. UTILIZATIONS OF MANETS

Electronic brake lights, which permit a driver (or an independent auto or truck) to respond to vehicles braking despite the fact that they may be clouded (e.g., by different vehicles). Platooning, which enables vehicles to firmly (down to a couple of inches) take after a main node by remotely getting speeding up and directing data, along these lines framing electronically coupled "street trains". Activity data frameworks, which utilize MANET correspondence to give up-to-the moment hindrance reports to a vehicle's satellite route system

Street Transportation Crisis Services – where MANET correspondences, MANET systems, and street security cautioning and status data dispersal are utilized to lessen deferrals and accelerate crisis save activities to spare the lives of those injured.

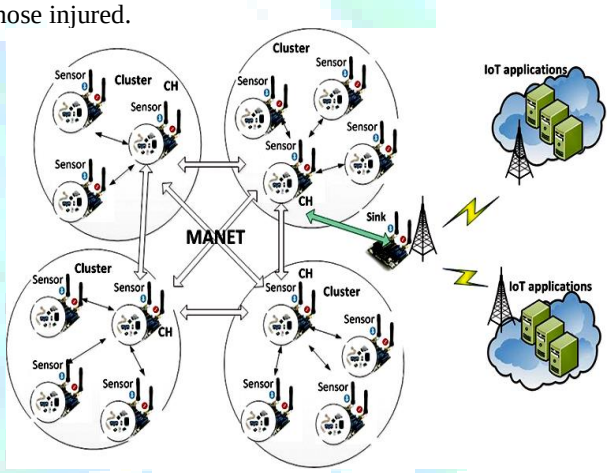

Figure 2: MANET routing model

The earliest remote information arrange is called "parcel radio" system, and was supported by Resistance Propelled Exploration Undertakings Organization (DARPA) in the mid 1970s. Jolt, Beranek and Newman Advances (BBN) and SRI Global outlined, fabricated, and explored different avenues regarding these most punctual frameworks. Experimenters included Robert Kahn, Jerry Burchfiel, and Beam Tomlinson. Comparative analyses occurred in the novice radio network with the x25 convention. These early bundle radio frameworks originated before the Web, and in fact were a piece of the inspiration of the first Web Convention suite. Later DARPA tests incorporated the Survivable Radio System (SURAN) project, which occurred in the 1980s. Another third flood of scholastic and research movement began in the mid-1990s with the approach of economical 802.11 radio cards for PCs. Current remote impromptu systems are composed fundamentally for military utility. Issues with parcel radios are:

(1) massive components,
(2) moderate information rate,
(3) unfit to keep up joins if portability is high.

The task did not continue considerably advance until the mid1990s when remote specially appointed systems are conceived.

II. LITERATURE REVIEW

There is various protocol for wireless network, ad-hoc networks etc. This section presents the previous work around the world based on protocol and their performance for network capacity enhancement.

Chen et al., **[1]** Due to significant advances in wireless modulation technologies, some MAC standards such as 802.11a, 802.11b, and 802.11g can operate with multiple data rates for QoS-constrained multimedia communication to utilize the limited resources of MANETs more efficiently. In this work, by means of measuring the busy/idle ratio of the shared radio channel, a method for estimating one-hop delay is first suggested. Then, by constructing a multicast tree, a delay-sensitive multicast protocol for real-time applications in multidate MANETs is proposed. In order to increase the network capacity, the proposed multicast protocol intends to minimize the sum of the total transmission time of the forwarders and the total blocking time of the blocked hosts, by taking the neighbouring information of the forwarders into account and properly adjusting the data rates of the forwarders. Simulation results show that the proposed delay estimation method is more accurate, as compared with previous works. Besides, the proposed multicast protocol can induce higher network capacity, while satisfying the delay requirement.

E. H. Wu et al., **[2]** Network coding is a promising technology proven to improve the performance of wireless networks. To successfully design a quality-of-service (QoS)-satisfied routing protocol with network coding, the bandwidth consumption of a coding host should be determined. Furthermore, coding opportunities should be increased to improve network capacity. Nevertheless, it is challenging to determine whether a host can be a coding host and to determine the bandwidth consumption of a coding host in a mobile ad hoc network (MANET). In this work, it is first present and define the coding conditions to identify a coding host. The bandwidth consumption of a coding host is then estimated under the contention-based wireless networks with a random-access mechanism. Finally, it is proposing a bandwidth-satisfied and coding-aware multicast routing protocol (BCMRP). By taking into account the residual bandwidth of the carrier-sense neighbours of the forwarders, the proposed protocol can satisfy the bandwidth requirements of the requested flow and other ongoing flows. As a consequence of considering coding opportunities in multicast tree construction, the proposed multicast protocol can reduce the total bandwidth consumption. The simulation results show that BCMRP outperforms the prior multicast routing protocols in receiving ratio, admission ratio, and total bandwidth consumption.

P. R. Satav et al., **[3]** The research in MANET has been carried out for the development of various techniques which will increase the competency of the network only. A plenty number of proposed routing protocols are magnificent in terms of efficiency. However, proposed protocols were generally fulfilling the set of trusted network and not considered for adversarial network setting, hence there is no security mechanism has been considered. MANET is widely used in sensitive fields like battlefield, police rescue operation and many more in such type of sensitive field an attacker may try to gather information about the conversation starting from the origin node to the terminal node. Secure route selection approach for route selection in adverse environment is discussed in this article. The results shows that proposed algorithm, will resolve the single & collaborative attack by increasing the computational & storage overhead and by improving the significant PDR, achieves a noticeable enhancement in the end to end delay.

J. Kniess et al., **[4]** The search for service providers (e.g., ambulance, fire truck, etc.) after a disaster, must take place within a short time. Therefore, service discovery protocol which looks for providers that can attend victims, respecting time constraints, is crucial. In such a situation, a commonly solution for ensuring network connectivity between victims and providers is ad hoc networks (MANET), composed by battery-operated mobile nodes of persons (victims or not). However, an efficient service discovery protocol must care about energy consumption of mobile nodes and also prevent useless movement of providers. These are the aims of the Resource Reservation Protocol (ΔRRP), presented in this paper. Applying both Gauss-Markov [1] and Mission Critical Mobility [2] models to characterize human mobility, performance evaluation results on the Network Simulator NS2 confirm the effectiveness of ΔRRP protocol when compared to other protocols.

M. Maragatharajan et al., **[5]** A Multicast routing protocols for Mobile Ad hoc remote system assumes an essential part in the typical applications of ad hoc wireless networks, namely, emergency & rescue operations, Distributed & Collaborative computing, Wireless mesh networks and etc. Multicasting is nothing but send information not to all members but for a group of members. It is the most favoured technique for group communication because it decreases overhead and improves transmission capacity use. Multicasting in a mobile and multi hop wireless network is considerably more complex than in wired networks due to node mobility, Security, Energy management, Routing, Addressing and deployment considerations. This work discusses some state-of-the-art multicast routing for mobile ad hoc network. Protocol comparison table can also be given.

P. Nekrasov et al., **[6]** In this work it is present Local Group Connected Dominating Set (LG-CDS) algorithm which can be used in conjunction with SMF protocol for multicasting in MANETs. LG-CDS performs distributed election of relays for connecting members of locally located groups using only two-hop neighborhood information. It is worth noting that the

algorithm can be tuned to elect redundant relays to improve fault tolerance. Using simulation in ns-3 it is evaluate the performance of LG-CDS and show that our approach provides high network capacity while being stable to topology changes.

M. A. Gawas et al., **[7]** To support QoS for a multimedia traffic, IEEE 802.11e standard Enhanced distributed channel access (EDCA) has been proposed. However, the EDCA is more focused on providing quality of service(QoS) solution at the MAC layer, which is necessary, but perhaps not sufficient as the layered TCP stack architecture does not satisfy the QoS demands in ad hoc network. This is due to the fact that routing protocol is responsible for the successful packet delivery and QoS Support. The conventional single scalar routing protocols are not suitable for high traffic QoS sensitive multimedia traffic load on Mobile ad Hoc Networks (MANETs). The work proposes a Cross layer Multimetric link disjoint Multipath Routing (CMMR) protocol based on distinct QoS constraints. The work uses cross-layer communications to consider multiple layer metrics like MAC queue utilization, node density degree, and mobility factor to achieve channel state awareness and keep the up to date status of the route in terms of QOS proficiency at each intermediate node. The proposed algorithm is validated with an extensive simulation with high real time traffic using NS3. The results show significant improvement of CMMR in terms of packet delivery, and end-to-end delay.

J. Maxa et al., **[8]** UAV Ad hoc NETworks (UAANETs) can be defined as a new form of ad hoc networks in which nodes are Unmanned Aerial Vehicles (UAVs) and Ground Control Station (GCS). Compared to the usual Mobile Ad hoc NETwork (MANET), this new network paradigm has some unique features and brings specific challenges such as node mobility degree, network connectivity patterns, delay-sensitive applications and network security. Indeed, from routing point of view, none of the several UAANET routing protocols proposed in the literature have been designed with security in mind. This lack of consideration can make the certification of UAANETs difficult to obtain. In this work, it is present our vision of such a challenge and the research that it is are conducting. The aim is to propose an original secure routing protocol for UAANETs using a Model Driven Development (MDD) approach which will ease the certification of final UAV products. The first preliminary results concerning our secure-routing protocol design will be presented. This work describes our ongoing research which will provide secure communications for UAV ad hoc networks at the end of the SUANET (Secure Uav Ad-hoc NETwork) project.

P. Novotny et al., **[9]** it is are concerned with reliably harvesting data used to monitor a service-based system hosted in a mobile ad hoc network (MANET) environment. These data are time-bounded, time-sensitive time-series data recorded by individual hosts in the network. Harvesting is used to gather the data for global time-series analyses, such as fault localization. The MANET environment challenges data harvesting, due to the inherently unstable and unpredictable connectivity and the resource limitations of wireless devices. it is present an epidemic, delay tolerant method to improve the availability of time-series monitoring data in the presence of network instabilities, asymmetries, and partitions. The method establishes a network-wide synchronization overlay to incrementally and efficiently move data to intermediate nodes. it is have implemented the algorithm in Java EE and evaluated it in the CORE and EMANE MANET emulation environments.

B. S. Bhati et al., **[10]** Data privacy is one among the challenging issues in Mobile Ad hoc NETworks (MANETs), which are deployed in hostile environments to transfer sensitive data through multi-hop routing. The undesired disclosure of data can result in breach of data privacy, and can be used in launching several attacks. Many of the works achieved data privacy by using approaches such as data transformation, data perturbation, etc. But, these approaches introduce high computational overheads and delays in a MANET. To minimize the computations in preserving data privacy, it is have proposed a computational intelligence based data privacy scheme. In the scheme it is use data anonymization approach, where rough set theory is used to determine the data attributes to be anonymized. Dynamically changing multiple routes are established between a sender and a receiver, by selecting more than one trusted 1-hop neighbour nodes for data transfer in each routing step. Anonymity of the receiver is also discussed. The work has been simulated in different network sizes with several data transfers. The results are quite encouraging.

S. Jelassi et al., **[11]** Mobile Ad-hoc Networks (MANET) have been initially proposed for short-session exchanges of small data chunks in emergency and tactical missions, where network' infrastructure is inexistent or temporally broken. The quick rise of processing and communication capabilities of mobile devices allows moving toward offering user-friendly and delay-sensitive multimedia services over a MANET. The integration of multimedia services needs a good understanding of the effects of MANETs on the applications running contexts. This work aims at exploring network delay processes of packet voice communications on mobile ad-hoc networks. To do that, a wide range of representative scenarios has been defined and simulated. The gathered traces have been inspected from qualitative and quantitative perspectives in order to discover (1) dependency between up/down path lifetime and delay variation processes, and (2) features of network delay variation at transport-layer.

C. Lal et al., **[12]** In this work, it is present an adaptive delay-aware multipath routing (ADAMR) framework for reliable transmission of delay-sensitive applications over mobile ad-hoc networks (MANETs). The proposed method uses cross-layer design to abstract the Quality-of-Service (QoS) constraints of requesting applications in terms of end-to-end delay. To ensure that each admitted data session packet gets the required delay, it is use an adaptive flow admission control technique. The proposed admission control procedure admits only those data sessions for which our multipath routing protocol is able to find

a delay-aware route. Proposed multipath routing protocol not only discovers routes that satisfy the given delay constraints, but also makes sure that the discovered routes are node-disjoint. When a link break is detected on an active route, it is use backup route to bypass another overhead generating route discovery process. Extensive simulations prove the effectiveness of the proposed approach under various network scenarios. it is use H.264/SVC encoded video traces to model the video source nodes in the network. The proposed method provides required QoS guarantees and perform congestion control based on the current network load levels. It is also observed from simulation results that ADAMR performs accurate admission control and discovers stable multiple node-disjoint routes with minimal routing overhead.

V. Meena et al., **[13]** Recently multicast routing protocols become increasingly important aspect in mobile ad hoc networks (MANETs), as they effectively manage group communications. In this work, it is addressing the scalability problem of multicast routing protocols to support energy efficient paths over MANETs. In this work a new position-based energy efficient multicast routing protocol is introduced. Here the network area is divided into the equal sized hexagonal cells. For each cell, cell head (CH) is elected. In this novel approach cell head backup is elected only if the cell contains any multicast member. Our approach reduces the energy constraint by choosing the cell head, cell head backup and forwarding nodes based on the highest battery capacity. The protocol also increases the lifetime of the node and network. Simulation results show that PAEEM provides higher packet delivery ratio and provides less energy consumption compared to PBQMRP protocol.

C. Fathy et al., **[14]** In order for Mobile Ad hoc Networks (MANET) to support service requirements of multimedia and real-time applications, the underlying routing protocol must provide Quality of Service (QoS) in terms of average End-to-End Delay (ETED). Towards this end, it is investigating a number of conventional routing protocols, such as AODV (reactive routing) and DSDV (proactive routing), under different traffic and mobility conditions to obtain the lowest average ETED. Then, it is developing a new routing protocol that enables each mobile node to separately switch between reactive routing mode and proactive routing mode based on the current node status. It utilizes a fuzzy-based routing mode selector whose inputs are the number of link breaks (LB), the interface queue (IFQ) length, and the type of application for each node (whether Delay-Tolerant "DT" or Delay-Sensitive "DS"). In this work, applications of interest are delay-sensitive and, therefore, the type of application of each node is set to be Delay-Sensitive ("DS"). Since the selection of the routing protocol (which belongs to Layer 3) is determined based on Layer 1 information (LB), Layer 2 information (IFQ Length) and Layer 7 information (type of application), it is called Adaptive Cross-layer Routing Protocol (ACRP). Using ns-2 network simulation package, it has been shown that the new adaptive routing protocol outperforms AODV by up to 95.3% in average ETED, and up to 84.5% in Route Discovery Latency. Likewise, it outperforms DSDV by up to 95.5% in average ETED, and up to 85.7% in Route Discovery Latency. Moreover, when compared to other QoS-MANET routing protocols, the new protocol achieves improvement in average ETED of up to 83.8% (in case of AMDR), up to 75% (in case of NQoS AODV) and up to 32% improvement in Packet Delivery Ratio (PDR) (in case of N QoS AODV).

M. Obaidat et al., **[15]** This work proposes a QoS multipath routing protocol (QMRP) for MANETs based on the single path AODV routing protocol. QMRP establishes node-disjoint paths that experience the lowest delay. Other delay-aware routing protocols do not factor in the projected contribution of the node requesting a route in the total network load. The implication is that the end-to-end (E2E) delay obtained through RREQ is no longer accurate. Unlike its predecessors, QMRP takes into account the projected contribution of the source node in the calculation of E2E delay. To obtain accurate estimate of path delay, QMRP uses cross-layer communication to achieve link and channel-awareness. Performance evaluation of QMRP and comparison with AODV using OPNET show that QMRP outperforms AODV in terms of average throughput, delay and packet loss has been conducted.

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III. PROBLEM IDENTIFICATION

It is distinguished issue of low parcel conveyance proportion, more normal end to end defers and all the more directing overhead. With the web and computerized innovation obscuring the limits between substance, correspondence, and media writes, nowadays you're similarly prone to tune into a show, motion picture, or network show on your cell phone, as you are to get a similar occasion on radio, at a silver screen, or through your home diversion framework. This progress may seem consistent, yet in the background, there are distinctive methods of transmission at work, and diverse difficulties which should be met by the source, course, and recipient of every transmission. In this article, we'll be looking into the foremost strategies utilized as a part of transmitting data and flags in the computerized time of systems administration and interchanges. A unicast transmission is a balanced correspondence that goes from a solitary source to a solitary recipient or goal. One of the least complex regular cases of unicast transmission would be a telephone call between two individuals. In processing terms, unicast transmission is the most well-known technique for data exchange which happens on systems. Activity as floods of information bundles normally moves from a solitary host, (for example, a web server) to a solitary endpoint, (for example, a customer application, PC, or program).

Despite the fact that a unicast transmission is point to point, a similar data might be passed from the source hub to any number of different hubs on the system, in a progression of coordinated interchanges. An imitation of every parcel in the information stream goes to each host on the system that solicitations it. All the more in fact, unicast transmission utilizes Web Convention or IP arrangement strategies, for example, transmission control convention (TCP) and client

datagram convention (UDP). These are session-based conventions which enable a correspondence to be set up, finished, and ended as a solitary task. A unicast transmission is sent to a solitary hub on the system, which is recognized by a remarkable 64-bit address. Unicast transmission has been being used for quite a while, with settled conventions and simple to convey strategies. Surely understood and confided in applications, for example, http, smtp, ftp and telnet all utilization the unicast standard and utilize the TCP transport convention. On a system, transmission happens from host to have, which can diminish the activity load on a Neighborhood (LAN), in general. In the event that a system gadget is called upon to make an impression on different hubs, it needs to send numerous unicast messages, each routed to a particular gadget. This initially requires the sender to know the correct IP address of every goal gadget. Each unicast customer that interfaces with the host server goes through some system transfer speed. In the event that various customers are included, this may present scaling issues the extent that system and server assets are concerned. The issue turns out to be considerably more articulated if numerous hosts are transmitting by means of unicast to numerous recipients, in the meantime.

Therefore, problem statement can be summarized as followings-

- N2N ad-hoc communication protocols without RSU coverage are needed to be designed and simulated so that the performance analysis results could be more reliable.
- Less throughput.
- More End-to-End delay and more Packet loss.
- More transmission times.

B. Challenges

A few books and works have uncovered the specialized and research challenges confronting remote impromptu systems or MANETs. The points of interest and difficulties (cons) can be quickly outlined beneath.

- Favorable circumstances
- Very performing system.
- No costly framework must be introduced
- Utilization of unlicensed recurrence range
- Snappy circulation of data around sender
- No single purpose of disappointment.
- All system substances might be portable extremely unique topology
- System capacities must have high level of versatility
- No focal elements ⇒ activity in totally dispersed way.
- RADIOS FOR Impromptu

IV. SIMULATION SOFTWARE

MATLAB (matrix laboratory) is a numerical processing condition and fourth-age programming language. Created by Math Works, MATLAB allows lattice controls, plotting of capacities and data, usage of calculations, making of UIs, and interfacing with programs written in different dialects, including C, C++, Java, and Fortran.

In spite of the fact that MATLAB is expected basically for numerical registering, a discretionary tool stash utilizes the MuPAD representative motor, allowing access to emblematic figuring capacities. An extra bundle, Simulink, includes graphical multi-area reproduction and Model-Based Structure for dynamic and inserted frameworks.

In 2004, MATLAB had around one million clients across industry and the scholarly community. MATLAB clients originate from different foundations of building, science, and financial aspects. MATLAB is generally utilized in scholastic and examination establishments just as mechanical ventures

The expression "MATLAB" is recognizable to each Building graduate. MATLAB is a logical computational bundle that has been generally being used since the time its initiation in the mid-nineties. At the outset it was constrained to the exploration field however later it increased a noticeable spot in the building course prospectus, particularly the Electrical and Hardware branches.

MATLAB is a scientific and graphical programming bundle; it has numerical, graphical, and programming capacities. It has worked in capacities to do numerous activities, and there is tool stash that can be added to increase these capacities (e.g., for signal preparing). There are adaptations accessible for various equipment stages, and there are both expert and understudy versions. At the point when the MATLAB programming is begun, a window is opened: the primary part is the Command Window.

V. CONCLUSION

In this survey paper discuss on different previous work presented by different researchers on multi path mobile ad-hoc network. Also discuss the different challenges face in mobile ad-hoc network deployment. Simulation of MANET is an important part of research work. In this presented work also discuss the MATLAB and its utilization for the implementation of the MANIT. In the nut shall discuss the MANET and its different research presented in the last decade by different researchers.

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