Recent Advances in Routing with AODV, DSR, DSDV Protocols for Mobile Ad-hoc Networks

Anand Kumar Jha [1], Raman Kumar Sethi [2]

[1] *A.P.in ECE, Satya College of Engineering & Technoloogy, Palwal, Haryana, India*
[2] *M.Tech. Student(ECE), Satya College of Engineering & Technoloogy, Palwal, Haryana, India*

***Abstract*— Mobile Ad hoc Web (MANET) is a collection of wireless mobile nodes that vibrantly form a web temporarily lacking each prop of central administration. Moreover, Every single node in MANET moves arbitrarily making the multi-hop web topology to change randomly at unpredictable times. There are countless acquainted routing protocols like DSDV, AODV, DSR, etc… that have been counseled for bestowing contact amid all the nodes in the network. This paper presents a presentation analogy of proactive and reactive protocols DSDV, AODV and DSR established on metrics such as throughput, packet transport ratio and average end-to-end stay by employing the NS-2 simulator.**

Index Terms— MANET, AODV, DSR, DSDV, Proactive Routing, Reactive Routing

I. INTRODUCTION

A Mobile Ad-hoc Web (MANET) is a collection of wireless nodes that can vibrantly be set up anywhere and anytime lacking employing each pre-existing web infrastructure. It is an self-governing arrangement in that mobile hosts related by wireless links are free to move randomly and frequently deed as routers at the alike time. The topology of such webs is probable exceedingly vibrant because every single web node can freely move and no pre-installed center stations exist. Due to the manipulated wireless transmission scope of every single node, data packets next could be forwarded alongside multihops. Route assembly ought to be completed alongside a minimum of overhead and bandwidth consumption. As their rise in the 1970s, wireless webs have come to be increasingly accepted in the computing industry. This is chiefly real inside the past decade, that has perceived wireless webs being adapted to enable mobility. AODV is perhaps the most well-known routing protocol for MANET , that is a hop-by-hop reactive (On demand) basis routing protocol, merges DSR and DSDV mechanisms for routing, by employing the on-demand mechanism of routing invention and path maintenance from DSR and the hop-by-hop routing and sequence number from DSDV. For every single destination, AODV creates a routing table like DSDV, as DSR uses node cache to uphold routing information. It proposals quick adaptation to vibrant link conditions, low processing and recollection overhead, low web utilization, and determines unicast paths to destinations inside the Ad-hoc network. Destination-Sequenced Distance Vector (DSDV) routing protocol is a normal routing protocol for MANETs, that is established on the Distributed Bellman-Ford algorithm. In DSDV, every single path is tagged alongside a sequence number that is started by destination, indicating how aged the path is. All nodes endeavor to find all trails to probable destinations nodes in a web and the number of hops to every single destination and save them in their routing tables. New path shows encompass the address of destination, the number of hops to grasp the destination, the sequence number of the data accord considering the destination, as well as a new exceptional sequence number for the new path broadcast.

Wireless networking is an growing knowledge that permits users to admission data and services electronically, even though of their geographic position. Wireless webs can be categorized in two types:-

A. Centralized Approach or Infrasrructure Networks

Infrastructure web consists of a web alongside fixed and wired gateways. A mobile host communicates alongside a connection in the web (called center station) inside its contact radius. The mobile constituent can move geographically as it is communicating. After it goes out of scope of one center station, it links alongside new center station and starts conversing across it. This is shouted handoff. In this way the center stations are fixed.

B. Decentralized Approach or Infrasrructureless(Ad-hoc) Networks

In difference to groundwork established wireless web, in ad-hoc webs all nodes are mobile and can be related vibrantly in an arbitrary manner. A MANET is a collection of wireless mobile nodes growing a provisional web lacking employing each continuing groundwork or each official support. The wireless ad-hoc webs are self-creating, self-organizing and self-administrating. The nodes in an ad-hoc web can be a laptop, cell phone, PDA or each supplementary mechanism capable of conversing alongside those nodes placed inside its transmission range. The nodes can purpose as routers, that notice and uphold paths to supplementary nodes. The ad-hoc web could be utilized in emergency search-and-rescue procedures, battlefield procedures and data buy in inhospitable terrain. In ad-hoc webs, vibrant routing protocol have to be demanded to retain the record of elevated degree of node mobility, that frequently adjustments the web topology vibrantly and unpredictably.

II. ROUTING PROTOCOLS

The continuing routing protocols in MANETs can be categorized into three categories. Figure 1 displays the association alongside a little examples of continuing MANET protocols.

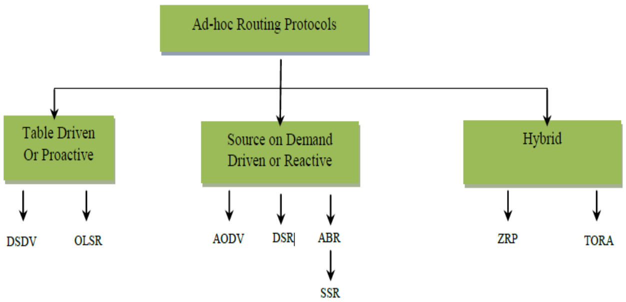


Figure 1 Classification of MANET's Routing Protocols.

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

The Ad Hoc On-Demand Distance Vector routing protocol (AODV) is an enhancement of the Destination-Sequenced Distance Vector routing protocol (DSDV). DSDV has its efficiency in crafting tinier ad-hoc networks. As it needs periodic advertisement and global dissemination of connectivity data for correct procedure, it leads to recurrent system-wide broadcasts. Consequently the size of DSDV ad-hoc webs is powerfully limited. After employing DSDV, every single mobile node additionally needs to uphold a finished catalog of paths for every single destination inside the mobile network.

The supremacy of AODV is that it attempts to minimize the number of needed broadcasts. It creates the paths on a on-demand basis, as challenged to uphold a finished catalog of paths for every single destination. Therefore, the authors of AODV categorize it as a pure on-demand path buy system.

1) Path Discovery Process:

When trying to dispatch a memo to a destination node lacking knowing an alert route to it, the dispatching node will onset a trail invention process. A path appeal memo (RREQ) is shown to all acquaintances, that tolerate to show the memo to their acquaintances and so on. The forwarding procedure is endured till the destination node is grasped or till a intermediate node knows a path to the destination that is new enough. To safeguard loop-free and most present path data, every single node maintains two counters: sequence number and broadcast_ id. The broadcast_id and the address of the basis node exceptionally recognize a RREQ message. broadcast_id is incremented for every single RREQ the basis node initiates. An intermediate node can accord several duplicates of the alike path appeal show from assorted neighbors. In this case – if a node has by now consented a RREQ alongside the alike basis address and broadcast_id – it will discard the packet lacking showing it furthermore. After an intermediate node forwards the RREQ memo, it records the address of the acquaintance from that it consented the early duplicate of the show packet. This method, the reverse trail from all nodes back to the basis is being crafted automatically. The RREQ packet encompasses two sequence numbers: the basis sequence number and the last destination sequence number recognized to the source. The basis sequence number is utilized to uphold "freshness" data concerning the reverse path to the basis as the destination sequence number specifies what actuality a path to the destination have to have beforehand it is consented by the source.

When the path appeal show reaches the destination or an intermediate node alongside a new plenty path, the node replies by dispatching a unicast path answer packet (RREP) back to the node from that it consented the RREQ. So truly the packet is dispatched back reverse the trail crafted across show forwarding. A path is believed new plenty, if the intermediate node's path to the destination node has a destination sequence number that is equal or larger than the one encompassed in the RREQ packet. As the RREP is dispatched back to the basis, every single intermediate node alongside this trail adds a onward path entry to its routing table. The onward path is set alert for a little period indicated by a path timer entry. The default worth is 3000 milliseconds, as denoted in the AODV RFC. If the path is no longer utilized, it will be deleted afterward the enumerated number of time. As the RREP packet is always dispatched back the reverse trail instituted by the routing appeal, AODV merely supports symmetric links.

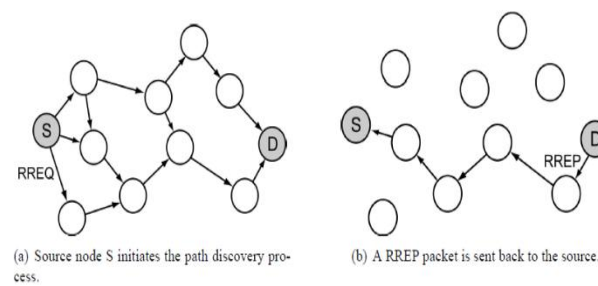


Figure 2 AODV Path Discovery Process.

2) Maintaining Routes:

If the basis node moves, it is able to dispatch a new RREQ packet to find a new path to the destination. If an intermediate node alongside the onward trail moves, its upstream acquaintance notices the move and sends a link wreck notification memo to every single of its alert upstream acquaintances to notify them of the erasure of that portion of the path (see Figure 3). The link wreck notification is forwarded as long as the basis node is not reached. Later possessing learned concerning the wreck, the basis node could reinitiate the path invention protocol. Optionally a mobile node could present innate connectivity maintenance by periodically showing hello messages.

B. Dynamic Source Routing (DSR)

The Vibrant Basis Routing (DSR) protocol is an on-demand routing protocol established on basis routing. In the basis routing method, a sender determines the precise sequence of nodes through that to propagate a packet. The catalog of

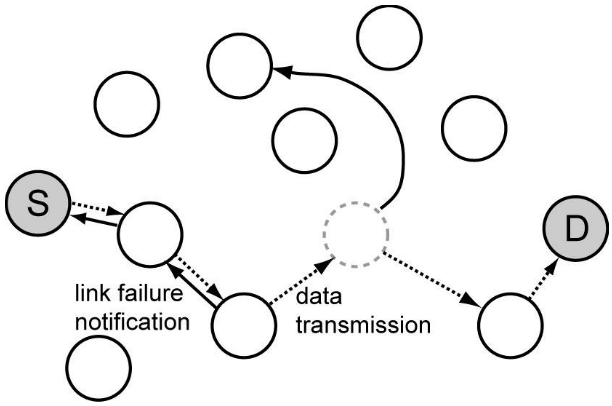


Figure 3 AODV Route Maintenance by using Link Failure Notification Message

intermediate nodes for routing is explicitly encompassed in the packet's header.

In DSR, every single mobile node in the web needs to uphold a path cache whereas it caches basis paths that it has learned. After a host wants to dispatch a packet to a little supplementary host, it early checks its path cache for a basis path to the destination. In the case a path is discovered, the sender uses this path to propagate the packet. Or else the basis node initiates the path invention process. Route invention and path maintenance are the two main portions of the DSR protocol.

1) Route Discovery:

For path invention, the basis node starts by showing a path appeal packet that can be consented by all acquaintance nodes inside its wireless transmission range. The path appeal encompasses the address of the destination host, denoted to as the target of the path invention, the source's address, a path record earth and a exceptional identification number. At the conclude, the basis host ought to accord a path answer packet encompassing a catalog of web nodes across that it ought to propagate the packets, hypothetical the path invention procedure was successful.

During the path invention procedure, the path record earth is utilized to amass the sequence of hops by now taken. Early of all the sender initiates the path record as a catalog alongside a solitary agent encompassing itself. The subsequent acquaintance node appends itself to the catalog and so on. Every single path appeal packet additionally encompasses a exceptional identification number shouted request_id. request_id is a easy counter that is increased whenever a new path appeal packet is being dispatched by the basis node. So every single path appeal packet can be exceptionally recognized across its initiator's address and request_id. After a host receives a path appeal packet, it is vital to procedure the appeal in the order delineated below. This method we can make sure that no loops will transpire across the showing of the packets.

1. If the pair (basis node address, request_id) is discovered in the catalog of present path demands, the packet is discarded.
2. If the host's address is by now tabulated in the request's path record, the packet is additionally discarded. This ensures removal of afterward duplicates of the alike appeal that appear by employing a loop.
3. If the destination address in the path appeal matches the host's address, the path record earth encompasses the path by that the appeal grasped this host from the basis node. A path answer packet is dispatched back to the basis node encompassing a duplicate of this route.
4. Otherwise, add this host's address to the path record earth of the path appeal packet and re-broadcast the packet.

A path answer is dispatched back whichever if the appeal packet reaches the destination node itself, or if the appeal reaches an intermediate node that has an alert route4 to the destination in its path cache. The path record earth in the appeal packet indicates that sequence of hops was taken. If the node producing the path answer is the destination node, it just seizes the path record earth of the path appeal and puts it into the path reply.

If the responding node is an intermediate node, it appends the cached path to the path record and next generates the path reply. Sending back path replies can be accomplished in two disparate manners: DSR could use symmetric links, but it is not needed to. In the case of symmetric links, the node producing the path answer just uses the reverse path of the path record. After employing unidirectional (asymmetric) links, the node needs to onset its own path invention procedure and piggyback the path answer on the new path request.

2) Route Maintenance:

Route maintenance can be accomplished by two different processes:

- Hop-by-hop acknowledgement at the data link layer
- End-to-end acknowledgements

Hop-by-hop acknowledgement at the data link layer permits a main detection and retransmission of capitulated or corrupt packets. If the data link layer determines a fatal transmission error (for example, because the maximum number of retransmissions is exceeded), a path error packet is being dispatched back to the sender of the packet. The path error packet encompasses two portions of information: The address of the node noticing the error and the host's address that it was trying to send the packet to. Whenever a node receives a path error packet, the hop in error is removed from the path cache and all paths encompassing this hop are truncated at that point.

End-to-end acknowledgement could be utilized, if wireless transmission amid two hosts does not work equally well in both directions. As long as a path exists by that the two conclude hosts are able to converse, path maintenance is possible. There could be disparate paths in both directions. In this case, replies or acknowledgements on the request or transport layer could be utilized to indicate the rank of the path from one host to the other. Though, alongside end-to-end acknowledgement it is not probable to find out the hop that has been in error.

C. Location Aided Routing (LAR)

Ad hoc on-demand distance vector routing (AODV) and distance vector routing (DSR) that have been beforehand delineated are both established on disparate variations of flooding. The aim of Location-Aided Routing (LAR) delineated in is to cut the routing overhead by the use of locale information. Locale data will be utilized by LAR for restricting the flooding to a precise span.

In the LAR routing method, path appeal and path answer packets comparable to DSR and AODV are being proposed. The implementation in the simulator follows the LAR1 algorithm comparable to DSR.

Location Information: When using LAR, any node needs to know its physical location. This can be achieved by using the Global Positioning System (GPS). Since the position information always includes a small error, GPS is currently not capable of determining a node's exact position. However, differential GPS5 offers accuracies within only a few meters.

Expected Zone: When a source node S wants to send a packet to some destination node D and needs to find a new route, it first tries to make a reasonable guess where D could be located. Suppose node S knows that at time t_0 D's position was P and that the current time is t_1. Using this information S is able to determine the expected zone of D from the viewpoint of node S by time t_1. For instance if D traveled with an average speed v, the source node S expects D to be in a circle around the old position P with a radius $v(t_1-t_0)$. The expected zone is only an estimate by S to determine possible locations of D. If D traveled with a higher speed than S expected, the destination node may be outside the expected zone at time t_1.

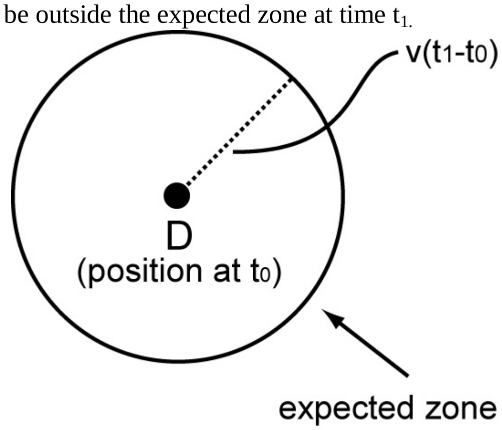


Figure 4 LAR Expected Zone.

If the basis node does not understand the locale of D at period t0, it will not be probable to guesstimate an anticipated zone. D might be anywhere. In this case, the whole ad-hoc web is selected as the anticipated zone and the routing algorithm reduces to a easy flooding.

Request Zone: Be S yet our basis node that wants to dispatch a packet to destination node D. The appeal zone is somewhat disparate from the anticipated zone, for it defines the zone whereas a path appeal ought to be forwarded from. An intermediate node will onward a path appeal packet merely, if it belongs to the appeal zone. This is disparate from the flooding protocols delineated before. Certainly the appeal zone ought to encompass the anticipated zone to grasp destination node D. The appeal zone could additionally contain more regions:

- To craft a trail from S to D, both nodes have to be encompassed in the appeal zone (Figure 5(a)). So if basis S is not encompassed in the anticipated zone of D, supplementary spans demand to be included. Or else the packet will not be forwarded from S to D.
- Under precise conditions there could be no path from S to D, even if both nodes are encompassed in the demanded zone (see Figure 5(b)). For instance, nodes that are adjacent, but beyond the appeal zone are demanded to propagate the packet. Thus, afterward a little timeout era, if no path is discovered from S to D, the appeal zone will be increased and S will onset a new path invention procedure (Figure 5(c)). In this case, the path determination procedure will seize longer because several path inventions are needed.

LAR Request Zone Types:

An intermediate node needs to use an algorithm to ascertain if it ought to onward a packet or not and if it is associate of the appeal zone or not. LAR defines two disparate kinds of appeal zones in order to do this. LAR Scheme 1 (LAR1) was utilized in our simulation, it is debated extra methodical below. More we remark LAR2 just for completeness.

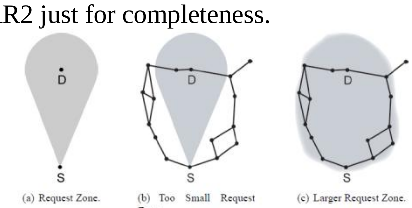


Figure 5 Different Request Zones.

LAR Scheme 1 (LAR1): The appeal zone of LAR1 is a rectangular geographic region. Remember: If basis node S knows a preceding locale P of destination node D at period t0, if it additionally knows its average speed v and the present period t1, next the anticipated zone at period t1 is a circle concerning P alongside radius r = v(t1 - t0). The appeal zone nowadays is described as the smallest probable rectangle that includes basis node S and the circular anticipated zone. More ought to the factions of the rectangle be parallel to the x and y axes.

The basis node is capable of ascertaining the four corners of the rectangular appeal zone. This four coordinates are nowadays encompassed in the path appeal packet after commencing the path invention process. Every single node that is beyond the rectangle enumerated by the four corners in the packet just drops the packet. As quickly as the destination

D receives the path appeal packet, it sends back a path answer packet as delineated in the flooding algorithms. Its answer differs by encompassing its present locale, the actual period, and as an option its average speed. Basis node S is going to use this data for a path invention in the upcoming.

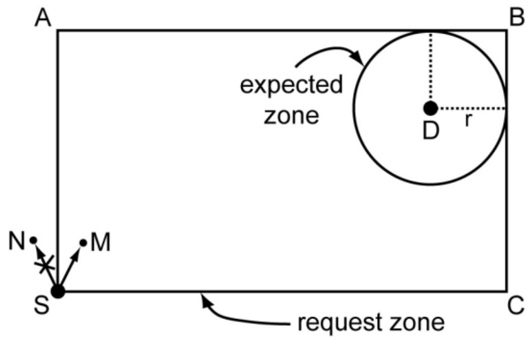


Figure 6 LAR Scheme 1 - Request Zone.

LAR Scheme 2 (LAR2): The subsequent LAR scheme is described by enumerating (estimated) destination coordinates (xd, yd) plus the distance to the destination. The approximated destination and the present distance to it are encompassed in the path request. Now, a node could merely onward the path appeal packet if it is closer or at maximum farther away than the preceding node. δ is a arrangement parameter that is dependant on implementation. Every single forwarding node overwrites the distance earth in the packet alongside its own present distance to the destination. This procedure ensures that the packet moves towards the destination.

D. Zone Routing Protocol (ZRP)

In a mobile ad-hoc web, it can be consented that most of the contact seizes locale amid nodes close to every single other. The Zone Routing Protocol (ZRP) delineated in seizes supremacy of this fact and divides the whole web into overlapping zones of variable size. It uses proactive protocols for discovering zone acquaintances (instantly dispatching hello messages) as well as reactive protocols for routing intentions amid disparate zones (a path is merely instituted if needed). Every single node could delineate its own zone size, whereby the zone size is described as number of hops to the zone perimeter. For instance, the zone size could depend on gesture strength, obtainable domination, reliability of disparate nodes etc. As ZRP is not a extremely different protocol, it provides a framework for supplementary protocols.

First of all, a node needs to discover its neighborhood in order to be able to build a zone and determine the perimeter nodes. In Figure 7, all perimeter nodes are printed in dark gray color – they build the border of A's zone with radius $\rho = 2$. The detection process is usually accomplished by using the Neighbor Discovery Protocol (NDP). Every node periodically sends some hello messages to its neighbors. If it receives an answer, a point-to-point connection to this node exists. Nodes may be selected by different criteria, be it signal strength, radio frequency, delay etc. The discovery messages are repeated from time to time to keep the map of the neighbors updated.

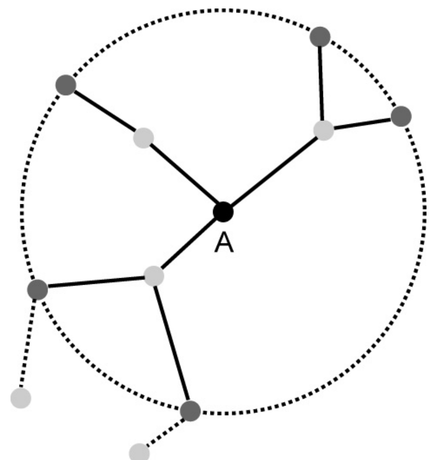


Figure 7 ZRP - Routing Zone of Node A, $\rho = 2$

The routing procedures inside a zone are given by the Intrazone Routing Protocol (IARP). This protocol is accountable for determining the paths to the peripheral nodes of a zone. It is usually a proactive protocol. A supplementary kind of protocol is utilized for the contact amid disparate zones. It is shouted Interzone Routing Protocol (IERP) and is merely accountable for routing amid peripheral zones. A third protocol, the Bordercast Resolution Protocol (BRP) is utilized to optimize the routing procedure amid perimeter nodes. Thus, it is not vital to deluge all peripheral nodes, what makes queries come to be extra efficient. Below, the three protocols are delineated in extra detail.

1) Intrazone Routing Protocol (IARP):

The IARP protocol is utilized by a node to converse alongside the supplementary inside nodes of its zone. A vital aim is to prop unidirectional links, but not merely symmetric links. It occurs extremely frequently, that a node A could dispatch data to a node B, but node B cannot grasp node A due to interference or low transmission manipulation for example. IARP is manipulated to the size of the zone ρ. The periodically showed path invention packets will be initialized alongside a Period To Live (TTL) earth set to ρ -1. Every single node that forwards the packet will nowadays cut this earth by one till the perimeter is reached. In this case, the TTL earth is 0 and the packet will be discarded. This makes sure that an IARP path appeal will not ever be forwarded out of a node's zone.

As by now remarked, IARP is a proactive, table-driven protocol for the innate area could change quickly, and adjustments in the innate topology are probable to have a bigger encounter on a nodes routing actions than a change on the supplementary conclude of the web. Proactive, table driven routing brings a fast, effectual find of paths to innate hosts. Native paths are instantly available. Therefore, every single node periodically needs to notify the routing data inside the zone. Additionally, innate path optimization is performed. This includes the pursuing actions.

- Removal of redundant routes
- Shortening of routes, if a node can be reached with a smaller number of hops
- Detecting of link failures and bypassing them through multiple local hops

2) Interzone Routing Protocol (IERP):

The Interzone Routing Protocol is utilized to converse amid nodes of disparate zones. It is a reactive protocol and the path invention procedure is merely commenced on demand. This makes path discovering slower, but the stay can be minimized by use of the Bordercast Resolution Protocol. IERP seizes supremacy of the fact that IARP knows the innate configuration of a zone. So a query is not presented to all innate nodes, but merely to a node's peripheral nodes. Furthermore, a node does not dispatch a query back to the nodes the appeal came from, even if they are peripheral nodes.

3) Bordercast Resolution Protocol (BRP):

The Bordercast Resolution Protocol is rather a packet transport ability than a maximum showcased routing protocol. It is utilized to dispatch routing demands generated by IERP undeviatingly to peripheral nodes to rise efficiency. BRP seizes supremacy of the innate chart from IARP and creates a bordercast tree of it. The BRP employs distinct query manipulation mechanisms to drive path demands away from spans of the web that have by now been obscured by the query. The use of this believed makes it far faster than flooding packets from node to node.

A methodical description of the Bordercast Resolution Protocol, encompassing its implementation is delineated in.

ZRP Example:

In order to make the routing process and the use of the Bordercast Resolution Protocol clearer, we are considering a simple, stationary example. Figure 8 shows a graphical representation of the network, and we still suppose $\rho = 2$. Node A tries to send a packet to node V, the zone border of node A is marked with gray color.

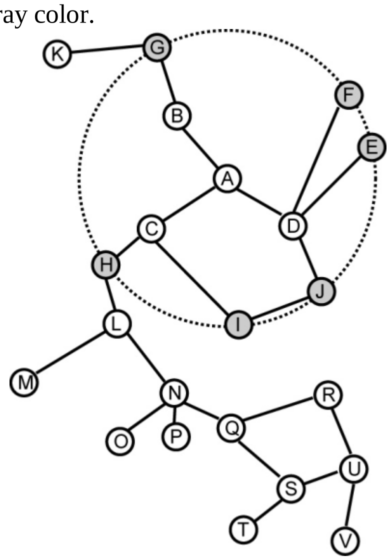
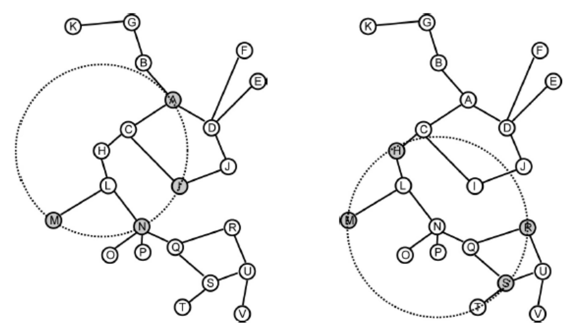


Figure 8 A Sample Network with $\rho = 2$.

First of all, node A needs to ascertain whether V is inside its own zone or not. For this patriotic, the Intrazone Routing Protocol (IARP) is used. Recall that IARP is proactive, A instantly knows that V is not inside its zone and initiates a path appeal employing the Interzone Routing Protocol (IERP). As delineated already, IERP nowadays uses the Bordercast Resolution Protocol (BRP) to optimize the request: The path appeal packet is not flooded to all nodes in A's zone, but merely to the peripheral nodes E, F, G, H, I and J. From nowadays on these nodes are hunting their own routing tables for a path to the destination.

Node H does not find V in its zone either. Consequently it bordercasts the appeal to its peripheral nodes (see Figure 9 (a)). The vital thing after employing BRP is that the bordercast tree of H does not encompass nodes A and I: those two nodes have by now been obscured by the routing request. So H propagates the path appeal merely to node M and N. As shown in Figure 9(b), N endures to bordercast the appeal to R and S (M and N have by now consented the request). In the end R and S both understand V inside their innate zone and dispatch back a path answer packet.



(a) Node H's Routing Zone. (b) Node N's Routing Zone.

Figure 9 A ZRP Routing Example.

III. RELATED WORK

Kiwior, D. et al, 2007 [1] Communications among mobile, tactical nodes presents a major military challenge. The use of MANET (Mobile Ad Hoc Network) protocols provides a possible solution for military nodes, including those in an airborne network. However MANET research has primarily focused on ground-based studies, using vehicular speeds and in many cases random mobility patterns. Nodes of an airborne network travel at speeds significantly faster than ground vehicles, and fly in coordinated paths not modeled by random mobility. In addition, the quality of the radio links for airborne nodes varies with time, due to interference, range, or antenna occlusion when banking. These characteristics make it impossible to extrapolate existing MANET research results to the airborne network. In this paper they present a simulation evaluation of MANET protocol performance for an airborne environment, with the intent to identify a routing protocol that can best deal with the dynamics of an airborne network. A scenario involving widebody aircraft trajectories was modeled in OPNET. Intermittent link outages due to aircraft banking were modeled by use of a notional radio link, antenna model, and modified OPNET source code that reflects positional antenna gain, including antenna occlusion when an aircraft banks. Within this scenario environment, four MANET protocols (AODV, TORA, OLSR, OSPFv3-MANET) were run on the airborne nodes with metric collection of protocol overhead, packet delivery ratio, and packet delay. Simulation results and analysis of the protocol performance for an airborne network are presented here. Additional issues and future areas of research are also identified.

Orwat, M.E. et al, 2008 [2] Mobile ad hoc networks (MANETs) rely on dynamic configuration decisions to efficiently operate in a rapidly changing environment of limited resources. The ability of a MANET to make decisions that accurately reflect the real environment depends on the quality of the input to those decisions. However, collecting and processing of the multitudinous factors related to the operation of a MANET is a significant challenge. Equally significant in current approaches to dynamic MANET management is the lack of consideration given to security factors. They show how their ontology of MANET attributes including device security and performance characteristics can be leveraged to efficiently and effectively make dynamic configuration decisions for managing a MANET.

Moursy, A. et al, 2008 [3] The performance of mobile ad hoc networks (MANETs) depends upon a number of dynamic factors that ultimately influence protocol and overall system performance. Adaptive protocols have been proposed that adjust their operation based on the values of factors, such as traffic load, node mobility, and link quality. In this work, however, they are investigating the feasibility of an adaptive model-based self-controller that can manage the values of controllable factors in MANETs. In general, the proposed self-controller should determine a set of factor values that will maximize system performance or satisfy specific performance requirements. The model-based controller adapts or reconfigures system-wide parameters or protocol operation as a function of the dynamically changing network state. In this paper, they describe the proposed self-controller, its design issues, and provide a preliminary case study to demonstrate the effectiveness and tradeoffs of two potential empirical-modeling techniques: regression and artificial neural networks.

Saeed, N.H. et al, 2008 [4] In Mobile Ad Hoc Network (MANET) many routing protocols exist, which are capable of routing data packets from source to destination. Each protocol is designed to fulfill its requirement; the constant network context (i.e. number of nodes, mobility, etc); but network context could be changed during the running time which affects the protocol performance and reduces its efficiency. In this paper, a MANET routing optimizer is presented which is capable of selecting the network context and the routing protocol. The optimizer is capable of choosing the optimum routing protocol according to networkpsilas context and give the optimum network context for the current network situation. It is adaptable of introducing alterations in the network environment by foretelling four important parameters that indicate the changes in the network context.

Kim, Sang-Chul et al, 2009 [5] This paper focuses on message complexity performance analysis of mobile ad hoc network (MANET) address autoconfiguration protocols (AAPs) in reference to link errors generated by mobile wireless nodes. An enhancement was made using a proposed retransmission limit, S, to be computed for error recovery (based on the link error probability), to measure message complexity of AAPs in reference to the link error probability, Pe. The control procedures for the retransmission limit have been included for each of the AAPs. Retransmission limit control is critical for efficient energy consumption of MANET nodes operating on limited portable energy. O-notation has been applied to analyze the upper bound of the number of messages generated by a MANET group of nodes. The AAPs investigated in this paper are strong duplicate address detection (DAD), weak DAD with proactive routing protocol (WDP), weak DAD with on-demand routing protocol (WDO), and MANETConf. Each AAP reacts different to link errors, as each AAP has different operational procedures. The required number of broadcasting, unicasting, relaying, and received messages of the nodes participating in a single-node joining procedure is investigated to asymptotically calculate the message complexity of each AAP. Computer simulation was conducted and the results have been analyzed to verify the theoretical message complexity bounds derived. The message complexity of WDP was lowest, closely followed by WDO, based on the simulation results and analysis of the message complexity under nominal situations. The message complexity of MANETConf was higher than WDO, and strong DAD resulted to be most complex among the four AAPs.

Bin-Wen Chuang et al 2005 [6] This paper presents the methodology of implementations and performance measurements of their mobile ad-hoc network (MANET) platforms. The work is prompted by the lack of published results concerning the issues associated with the implementation of MANET facilities on actual wireless networks, as opposed to results of simulation experiments. Our MANET is developed based on the settled IEEE 802.[7][8]b technology operating in the ad-hoc mode. The opportunity driven multiple access (ODMA), which is developed by IWICS Inc., is implemented on the platform and its performance has been examined through field tests along city streets. Based on the measurement results, ODMA-based MANET facilities are able to provide satisfactory wireless communication services in vehicular environments. The minimum data throughput of 20 kBytes/sec could be guaranteed in their testbed.

Saeed, N.H. et al, 2008 [7] In any mobile ad hoc network, a single routing system is in use during communication time without considering the MANET context, in spite the fact that MANET context affects the routing protocol performance. Changes in the MANET context lead to changes in the routing protocol behaviour for better or worse performance. This paper introduces a novel intelligent mobile ad hoc network routing system which is adaptable to the variations in the MANET context as the intelligent module selects four important parameters which indicate the changes in the network context. This intelligent system acquires the network's performance and then selects the optimum routing protocol that gives the best performance according to network context, such as: number and mobility of nodes. This module suggests the optimum network context for that situation.

Hinds, A. et al, 20[10]2 [8] This paper describes the need for a unified simulation framework which defines the simulation tools and configuration settings for researchers to perform comparative simulations and test the performance of security tools for the AODV MANET routing protocol. The key objectives of the proposed framework are to provide an unbiased, repeatable simulation environment which collects all important performance metrics and has a configuration optimized for the AODV protocols performance. Any security tool can then be simulated using the framework, showing the performance impact of the tool against the AODV baseline results or other security tools. The framework will control the network performance metrics and mobility models used in the simulation. It is anticipated that this framework will enable researchers to easily repeat experiments and directly compare results without configuration settings influencing the results.

Hamrioui, S. et al, 20[12][9] In this paper, they will study the interactions between medium access control (MAC) and Transfer Control Protocol (TCP) protocols. These interactions will be done with some of the IETF standardised reactive (AODV, DSR) and proactive (DSDV) routing protocols under varying network conditions such as load and mobility. They will suggest an improvement to these interactions for a better MANET performance. They especially interest to the TCP performance parameters like the sending rate of the TCP packets. This improvement is the IB-MAC (backoff improvement of the MAC protocol) which proposes a new backoff algorithm based on a dynamic adaptation of its maximal limit according to the number of nodes and their mobility. Finally, they will complete their study by showing the incidences of IB-MAC on MANET performance.

Arora, D. et al, 2015 [10] The wide deployment of smart phones has begun to make them pragmatic deployment environments for real-world at-scale MANETs (i.e., to provide peer-to-peer based non-cellular services). Such services, of course, will be subject to cyber-attacks, one of the simplest of which is radio frequency (RF) jamming. The success of these MANETs will require both: i) robust and accurate methods of detecting when jammers are present and ii) methods of mitigating jammer impacts. This work explores the effects that various jamming strategies have on MANET operations as observed via standard MANET operational measures such as: packet delivery ratio, delay, routing overhead, and hops travelled. It is shown that the detect ability of active jammers heavily depends both on which measure is used and the exact nature of the jamming strategy employed. Moreover, although basic approaches such as constant jamming are easily detectable, it is shown that little work is required to construct far less detectable jamming strategies.

Cano, J. et al, 2012 [11] Mobile ad hoc networks are highly dynamic networks that offer multihop communications in the presence of changing topologies without the need for any fixed infrastructure support. These networks can be useful in a wide variety of scenarios, but setting them up and deploying services on them is a difficult task, even for experienced users. In this article they present EasyMANET ÃÂ an extensible platform the main objective of which is to encourage the widespread adoption and use of MANETs by non-expert users. To achieve this objective, EasyMANET provides two essential elements: an address autoconfiguration system and a name resolution service known as Visual DNS. The autoconfiguration system allows users to join an 802.[20][21]-based MANET by establishing the parameters of their terminal interfaces quickly and transparently. Thereafter, Visual DNS offers a graphical view of MANET participants and gives users the possibility to access the services made available by other users. Examples are communication services (text-based chat, VoIP, videoconference), file sharing, and localization services. They performed several laboratory experiments, and evaluated the performance of EasyMANET based on address autoconfiguration time and Visual DNS performance. Results show that EasyMANET can be established within seconds, and EasyMANET applications are easy to use. In fact, over 360 students have tried using Easy- MANET without problems.

Sanchez-Iborra, R. et al, 2013 [12] MANETs are experiencing unstoppable growth due to their decentralized topology and their easy and low-cost deployment. The dynamic nature of MANETs entails the use of appropriate routing protocols to obtain good performance in the services supported by the network; even more if these services present tough temporal requirements, such as multimedia or VoIP services. One routing protocol to which notable research effort has been devoted is the BATMAN protocol, which proposes an interesting paradigm avoiding the explicit interchange of routing information among nodes. In this paper, they focus on evaluating the performance of BATMAN supporting VoIP traffic on low power-consumption nodes, from a Quality of Experience (QoE) point of view. Specifically, they evaluate the impact on BATMAN performance of [24]) the PHY layer, by employing a fading characterization of the transmission channel; 2) the number and density of ad-hoc nodes; and 3) node mobility. All the results obtained for BATMAN are compared with those attained by using the widely used OLSR routing protocol. From the results, they conclude that neither BATMAN nor OLSR in their respective current implementations are suitable enough for VoIP traffic support in MANETs composed of energy-saving nodes.

Spagnolo, P.A. et al,[13] in "Comparison of Proposed Ospf Manet Extensions" 2006 [25]4], the authors describe The open shortest path first (OSPF) routing protocol performs inefficiently when operated over certain types of mobile ad hoc networks (MANETs), such as those formed by using IEEE 802.[26][27] ad hoc radios. In 2003, the Internet Engineering Task Force (IETF) OSPF working group solicited proposals to extend OSPFv3 for IPv6 to operate efficiently in MANET environments. During design team consideration, two proposals were developed and discussed: overlapping relays with smart peering (OR/SP) and MANET designated routers (MDRs). The two proposals both reduce OSPF overhead using similar ideas, but there are a few key differences. In this paper, they compare the design and operation of these two proposals, and use a simulation-based study to isolate several performance characteristics. Using the results of this comparison, they explain why they consider MDRs to be more suitable than OR/SP for OSPF in MANET environments.

Stine, J.A.[14] in "Cross-Layer Design of MANETs: The Only Option" 2006 [28]5], the authors describe The current Internet protocol (IP) architecture model for mobile ad hoc network (MANET) routing protocol development ignores cross-layer effects by seeking to emulate as closely as possible the wireline architecture. Nevertheless, cross-layer effects are unavoidable and it is actually desirable to exploit these interactions to achieve greater performance. Further, support for cross-layer information flow is necessary for many of the applications envisioned for MANETs. They review the purpose of the IP architecture and argue that the MANET architecture model is not only unsuitable for exploiting cross-layer effects it also violates the very intent of the IP architecture. By focusing the standardization effort on making routing solutions and placing them at the point of integration, just above IP in the protocol stack, it effectively stifles the IP development goals of supporting local subnetwork optimization and long term innovation. They review issues of cross-layer design and then propose an alternative standardization effort that would preserve the opportunity for innovation while ensuring the integration of MANET subnetworks into larger integrated heterogeneous IP networks. Our proposal places MANET into its own subnetworking layer and then divides standardization into four parts: the interface to the MANET subnetwork, a heterogeneous routing protocol, mechanisms for cross-layer information flow, and a combined logical and spatially hierarchical addressing scheme. They identify several more radical MANET design proposals that depart substantially from the current model. All could be integrated into a larger heterogeneous IP network using their protocol approach

Ben Rhaiem, O. et al,[15] in "Routing protocols performance analysis for scalable video coding (SVC) transmission over mobile ad-hoc networks" 20[29]3 [30]6], the authors describe The main challenge of future wireless networks is providing quality of service and quality of experience to satisfy the consumer. This can be achieved by providing mechanisms that will serve optimally the users with the required system resources according to the QoS. Satisfying video consumer require enhancing video streaming quality. Therefore, video streaming over wireless network and particularly over MANET necessitate deeper investigations. In this context, this paper focused on performance analysis of routing protocol over MANET for scalable video streaming. In this work the video codec under evaluation is H.264/SVC and the routing protocols are DSR, AODV, DSDV and AOMD. Our evaluation carried using the Ns-2 simulators configured to support an ad-hoc environment. The QoS metrics used in this analysis are Packet Delivery Ratio (PDR), Average End-to-end Delay and packets loss rate.

Arora, D. et al,[16] in "On the statistical behaviors of network-level features within MANETs" 20[31][32] [33]7], the authors describe Event-based simulation has become a primary means of pursuing mobile ad hoc network (MANET) research. The stochastic nature of MANETs has been well studied with respect to mobility models, but less work has looked at the statistical behaviors of network layer features, (e.g., PDR, delay, hops and routing overhead). Fundamentally, issues such as have not been well explored. This work explores these issues through using the DYMO routing protocol and the OMNeT++ simulation framework as exemplars. By applying distribution free Kolmogorov-Smirnov goodness-of-fit tests it is shown that, for network-layer features: a) MANET start-up transients can persist far longer than previously reported, b) transient durations can vary significantly from feature to feature and with varying node velocities, and c) Monte-Carlo runs of a given MANET scenario can produce distinct behavioral modes. It is then discussed whether these issues are likely inherent to MANETs and their routing protocols or an artifact of OMNeT++.

Comparetto, G. et al,[17] in "Quantifying network performance of Mobile Ad-hoc Networks" 2008 [34]8], the authors describe The rapid deployment requirements, limited infrastructure, and mobile nature of tactical edge networks have led the Department of Defense (DoD) to investigate and implement mobile ad-hoc networks (MANETs) to support its mission needs. MANETs rely on spectrum as the transmission medium, and their performance depends heavily on the electromagnetic environment (EME) where they operate. Traditional methods of assessing MANET performance have been focused on link capacity and network throughput, without adequately accounting for the effects of the EME. The joint spectrum center of the defense spectrum organization (DSO/JSC) has developed the spectrum simulation testbed to adequately account for spectrum impacts on MANET performance. As part of the DSO/JSC spectrum simulation testbed development, a number of capability gaps were identified, specifically in areas of quantifying the relationship between spectrum requirements and MANET performance. The purpose of this paper is to report the results of a survey to identify the current capabilities to address MANET performance within the context of accounting for available spectrum and to describe two capabilities that were developed to help bridge the analysis gap in the area relating spectrum requirements to system performance predictions.

Del Duca Almeida, V. et al,[18] in "Performance evaluation of MANET and DTN routing protocols" 20[35]2 [36]9], the authors describe Unstructured mobile networks (UMNs) are mobile networks in which there is little or no pre-installed infrastructure (access points, antennas), and as such message forwarding is performed among the mobile nodes or within the wireless infrastructure. Routing in those networks occurs either using MANET approaches, where nodes build and end-to-end path among source and destination, or DTN routing, where nodes exchange cached messages whenever they enter in radio range with one another. One open question in the field, however, is when to use each of the approaches. Most UMN deployments lie on a gray zone, where it is hard to determine the most suitable protocol. This paper presents a performance evaluation of both approaches, in an attempt to identify when to employ each protocol.

Saeed, N.H. et al,[19] in "Intelligent MANET Routing Protocol Selector" 2008 [37], the authors describe Currently, in any Mobile Ad Hoc Network (MANET), one routing protocol routes the packets to their destination no matter what the network's context is! This 'one size fits all' approach is far from optimum. This paper introduces a novel intelligent routing protocol selector for MANET. The intelligent selector learns the network's performance and behaviour then chooses the optimum routing protocol according to the network's context, e.g.: number of nodes and mobility. The selector recommends the optimum network context depending on the current network situation. The selector is adaptable to the variations in the network environment by predicting four important parameters that indicate the changes in the network context. The intelligent selector system can deploy any protocol to its best advantages by testing the network's context and employing the most suitable protocol for that situation.

Wang Bei-Zhan et al,[20] in "Inference of Wireless Link Performance in MANET" 2007 [38]], the authors describe The link performance (loss rate and delay probability) inference is important for evaluating mobile ad hoc network (MANET). The crucial step is MANET topology identification. Since the majority of existing mobility models (MM) may not correctly reflect the true MANET performance, a novel MM based on circle movement is presented. With help of the model, they identify the MANET topology and its live time. MANET internal links performance inference process, which consists of unicast back-to- back packets probes sent from a sender to pairs of receivers, and the performance inference algorithms are presented. NS2 simulations validate the presented model and algorithms.

Saeed, N.H. et al,[21] in "IMAN: An Intelligent MANET routing system" 20[39]0 [40], the authors describe Currently, in any MANET, one protocol routes packets to their destination regardless of the network context. This `one size fits all' approach is far from optimum. Therefore, in this paper, they introduce an Intelligent MANet routing protocol system (IMAN), which employs Genetic Algorithms to select the most optimum protocol based on the network context. Comprehensive performance models of three MANET routing protocols (AODV, DSR and OLSR) were built based on the Neuro-Fuzzy Inference System. Representative MANET scenarios, with different number of nodes and mobility schemes, were tested by means of simulations. Findings indicated considerable reduction in packets delay and data load when IMAN was utilized.

Sarkar, N.I. et al,[22] in "A study of MANET routing protocols: Joint node density, packet length and mobility" 20[41]0 [42], the authors describe The dynamic topology of a mobile ad hoc network (MANET) poses a real challenge in the design of a MANET routing protocol. Over the last [43]0 years, a variety of routing protocols have been developed and their performance simulations are made by network researchers. Most of the previous research on MANET routing protocols have focused on simulation study by varying network parameters, such as network size (node density), pause times, or node mobility independently. This paper considers the problem from a different perspective, using a simulation model the combined effect of node density and packet length; node density and mobility on the performance of a typical 802.[44][45] MANET is investigated. This is a common and realistic scenario in MANETs where nodes move around, join and leave the network at any time. Based on the QoS (end-to-end delay, throughput), routing load and packet retransmissions, this paper systematically analyzes the performance of four diverse MANET routing protocols with the different simulation model and configurations, and drew more complete conclusions.

Bansal, A. et al,[23] in "Enhancing MANET's performance: A transport layer solution" 20[46]2 [47], the authors describe TCP is a reliable transport layer protocol basically designed for wired networks. In TCP, segment loss in transmission is due to congestion in the network rather than due to unreliable medium, the same is not true for Ad-Hoc networks, mainly MANET. MANET, a well known Ad-Hoc network is prone to link failures majorly due to mobility. In MANET, TCP is unable to distinguish between losses because of either route failures or congestion. Sometimes, TCP interprets wireless error as congestion. Aiming at the improvement in TCP over MANET, they focus on TCP New Reno, a widely used TCP variant. Similar to other TCP variant TCP New Reno suffers due to misinterpretation of cause of loss and ultimately degrade throughput. They modify and analyze this TCP variant to improve the transport layer performance over MANET. They know that routing plays an important role in MANET, therefore, they involve DSDV and AODV routing protocol in their study. Along with this, they analyze performance of both actual and modified TCP New Reno implementations in term of Packet Delivery Fraction and Throughput.

Wang Wei et al,[24] in "The Factor Graph Approach for Inferring Link Loss in MANET" 2008 [48], the authors describe The dynamic nature of topology makes it challengeable to estimate link loss rates in mobile ad hoc network (MANET). Firstly, simulation results based on existing mobility models have the unrealistic movement scenarios which may not correctly reflect true MANET performance. Secondly, it is difficult to identify MANET topology under these models due to phantasmagoric movements. This paper presents the circle movement mobility model (CMMM), which is superior to previous models, and its topology identification algorithm to characterize the dynamic MANET topology. Moreover, they present a loss inferring algorithmic based on modeling and computational methodology of factor graphs, which iteratively updates the estimates of link losses. The inference is a process based on unicast back-to-back packets probes sent from a sender to pairs of receivers. Without internal nodes' cooperations, the inference can be calculated using only information recorded at the end hosts. NS2 simulations show that the proposed algorithms exhibit good performance

IV. CONCLUSIONS

In this paper, the presentation of the three MANET Routing protocols such as DSDV, AODV and DSR was analyzed employing NS-2 Simulator. We have completed comprehensive simulation aftermath of Average End-to-End stay, throughput, and packet transport ratio above the routing protocols DSDV, DSR and AODV by fluctuating web size, simulation time. DSDV is a proactive routing protocol and suitable for manipulated number of nodes alongside low mobility due to the storage of routing data in the routing table at every single node. Assessing DSR alongside DSDV and AODV protocol, byte overhead in every single packet will rise whenever web topology adjustments as DSR protocol uses basis routing and path cache. Hence, DSR is preferable for reasonable traffic alongside reasonable mobility. As AODV routing protocol needs to find path by on demand, End-to-End stay will be higher than supplementary protocols. DSDV produces low end-to-end stay contrasted to supplementary protocols. After the web burden is low, AODV performs larger in case of packet transport ratio but it performs badly in words of average End-to-End stay and throughput. Overall, DSR outperforms AODV because it has less routing overhead after nodes have elevated mobility pondering the above said three metrics.

REFERENCES

[1]. Kiwior, D.; Lam, Lucas,"Routing Protocol Performance over Intermittent Links",IEEE,Military Communications Conference, 2007. MILCOM 2007. IEEE,2007

[2]. Orwat, M.E.; Levin, T.E.; Irvine, C.E.,"An Ontological Approach to Secure MANET Management",IEEE,Availability, Reliability and Security, 2008. ARES 08. Third International Conference on,2008

[3]. Moursy, A.; Ajbar, I.; Perkins, D.; Bayoumi, M.,"Empirical model-based adaptive control of MANETs",IEEE,INFOCOM Workshops 2008, IEEE,2008

[4]. Saeed, N.H.; Abbod, M.F.; Al-Raweshidy, H.S.; Raoof, O.,"Intelligent MANET routing optimizer",IEEE,Broadband Communications, Networks and Systems, 2008. BROADNETS 2008. 5th International Conference on,2008

[5]. Kim, Sang-Chul; Chung, Jong-Moon,"Analysis of link error effects in MANET address autoconfiguration protocols",IEEE,Communications and Networks, Journal of,2009

[6]. Bin-Wen Chuang; Jenn-Hwan Tarng; Lin, J.; Wang, C.,"System development and performance investigation of mobile ad-hoc networks in vehicular environments",IEEE,Intelligent Vehicles Symposium, 2005. Proceedings. IEEE,2005

[7]. Saeed, N.H.; Abbod, M.F.; Al-Raweshidy, H.S.,"Intelligent MANET Routing System",IEEE,Advanced Information Networking and Applications - Workshops, 2008. AINAW 2008. 22nd International Conference on,2008

[8]. Hinds, A.; Sotiriadis, S.; Bessis, N.; Antonopoulos, N.,"Performance Evaluation of Security Algorithms for the AODV MANET Routing Protocol",IEEE,Emerging Intelligent Data and Web Technologies (EIDWT), 20[57]2 Third International Conference on,20[58]2

[9]. Hamrioui, S.; Lalam, M.,"IB-MAC: Improvement of the backoff algorithm for better MAC - TCP protocols interactions in MANET",IEEE,Programming and Systems (ISPS), 20[61][62][63]0th International Symposium on,20[64][65]

[10]. Arora, D.; Millman, E.; Neville, S.W.,"Jamming Strategies in DYMO MANETs: Assessing Detectability and Operational Impacts",IEEE,Broadband, Wireless Computing, Communication and Applications (BWCCA), 20[67]2 Seventh International Conference on,20[68]2

[11]. Cano, J.; Cano, J.-C.; Chai Keong Toh; Calafate, C.T.; Manzoni, P.,"EasyMANET: an extensible and configurable platform for service provisioning in MANET environments",IEEE,Communications Magazine, IEEE,20[70]0

[12]. Sanchez-Iborra, R.; Cano, M.-D.; Garcia-Haro, J.,"Performance Evaluation of BATMAN Routing Protocol for VoIP Services: A QoE Perspective",IEEE,Wireless Communications, IEEE Transactions on,20[72]4

[13]. Spagnolo, P.A.; Henderson, T.R.,"Comparison of Proposed Ospf Manet Extensions",IEEE,Military Communications Conference, 2006. MILCOM 2006. IEEE,2006

[14]. Stine, J.A.,"Cross-Layer Design of MANETs: The Only Option",IEEE,Military Communications Conference, 2006. MILCOM 2006. IEEE,2006

[15]. Ben Rhaiem, O.; Chaari Fourati, L.,"Routing protocols performance analysis for scalable video coding (SVC) transmission over mobile ad-hoc networks",IEEE,Signal and Image Processing Applications (ICSIPA), 20[76]3 IEEE International Conference on,20[77]3

[16]. Arora, D.; Millman, E.; Neville, S.W.,"On the statistical behaviors of network-level features within MANETs",IEEE,Personal Indoor and Mobile Radio Communications (PIMRC), 20[79][80] IEEE 22nd International Symposium on,20[81][82]

[17]. Comparetto, G.; Marshall, J.; Mirhakkak, M.; Schult, N.; Schwartz, J.; Zhang, K.; DiOrio, D.; Thai, S.,"Quantifying network performance of Mobile Ad-hoc Networks",IEEE,Military Communications Conference, 2008. MILCOM 2008. IEEE,2008

[18]. Del Duca Almeida, V.; Oliveira, A.B.; Macedo, D.F.; Nogueira, J.M.S.,"Performance evaluation of MANET and DTN routing protocols",IEEE,Wireless Days (WD), 20[85]2 IFIP,20[86]2

[19]. Saeed, N.H.; Abbod, M.F.; Sulaiman, T.H.; Al-Raweshidy, H.S.; Kurdi, H.,"Intelligent MANET Routing Protocol Selector",IEEE,Next Generation Mobile Applications, Services and Technologies, 2008. NGMAST '08. The Second International Conference on,2008

[20]. Wang Bei-Zhan; Wang Ya-ping; Wang Wei; Lou Run-Yu,"Inference of Wireless Link Performance in MANET",IEEE,Convergence Information Technology, 2007. International Conference on,2007

[21]. Saeed, N.H.; Abbod, M.F.; Al-Raweshidy, H.S.,"IMAN: An Intelligent MANET routing system",IEEE,Telecommunications (ICT), 20[90]0 IEEE 7th International Conference on,20[92]0

[22]. Sarkar, N.I.; Lol, W.G.,"A study of MANET routing protocols: Joint node density, packet length and mobility",IEEE,Computers and Communications (ISCC), 20[94]0 IEEE Symposium on,20[95]0

[23]. Bansal, A.; Singh, M.,"Enhancing MANET's performance: A transport layer solution",IEEE,Parallel Distributed and Grid Computing (PDGC), 20[97]2 2nd IEEE International Conference on,20[98]2

[24]. Wang Wei; Cai Wan-Dong; Wang Bei-Zhan; Wang Ya-ping; Tian Guang-Li,"The Factor Graph Approach for Inferring Link Loss in MANET",IEEE,Internet Computing in Science and Engineering, 2008. ICICSE '08. International Conference on,2008

.