

A Scheme to Detect Wormhole attack, Applications and Examination of Routing Protocols in Wireless Sensor Network

K. Kumara Swamy, P. Manikandan

Abstract: *The development of remote correspondence & circuit innovation has accepted the improvement of a system includes recognizing, calculation and correspondence units that makes head ready to watch & react to a marvels in an exacting space. The structure of such a foundation is included of hundreds or thousands of little, ease, multi-functional gadgets which can detect process and convey utilizing short range handsets known as sensor center points. The interconnection of these centers framing a system called remote sensor organize. The point of this examination is to recognize the exhibition difficulties of WSN and break down their effect on the presentation of steering conventions. Therefore an intensive writing study is performed to perceive the issues impacting the directing conventions execution. At that point to approve the effect of distinguished difficulties from writing, an exact examination has been directed by mimicking diverse steering conventions, thinking about these difficulties and results are appeared. In view of achieved results from exact investigation and writing overview suggestions are made for enhanced assurance of convention concerning application nature within the sight of thought about difficulties.*

Index terms: *Wireless Sensor Network, FPGA, Protocols, Sensor network services, Sensor network deployment, sensor node, Active Node, CCU.*

I. INTRODUCTION

Remote correspondence blessed with various favorable circumstances over customary wired system and empowers to grow little, minimal effort, low power and multi-utilitarian detecting gadgets. those little detecting gadgets have the capacities of detecting, calculation, self locating out and correspondence known as sensors. Sensor is an unobtrusive device used to apprehend the incorporating situation of its scenario, accumulate information, and device it to attract a few massive records which can be used to look the wonders approximately its situation. the ones sensors can be assembled the use of tool locating out suggests to form a framework passing on remotely the usage of radio repeat channel. The fashion of those homogenous or heterogeneous sensor centers known as some distance off sensor orchestrate(WSN) [1].

Revised Manuscript Received on December 22, 2019.

K. Kumara Swamy, Assistant Professor, Department of Computer Science & Engineering, Malla Reddy Engineering College for Women, Maisammaguda, Hyderabad-500100.

Dr.P.Manikandan, Professor, HOD-Department of Computer Science & Engineering, Malla Reddy Engineering College for Women, Maisammaguda, Hyderabad-500100.

As per [11] course choice of each significance in correspondence design result in either organize delay by picking long courses comprising numerous sensor hubs or corrupt system life-time as far as short courses bringing about exhausted batteries. In addition, pointless burden on a system and deferral in activity debases application quality as well as squanders organize assets. Besides, as WSNs arrangement seen in basic applications so the requests for application differ as per its tendency. Various applications have various requests from arrange which can't be maintained a strategic distance from. Along these lines, there is a need of effective steering convention which ought not exclusively be fitting for the application requests yet additionally help coordinate as for its constrained assets and performs well. To apprehend and pick out fine guidance conference for an software program, it's far required to recognize the exacting requests of that software software program first and later on to pick out the proper conference to be completed and reproduced. There are a few steering conventions produced for WSNs. All these steering conventions have diverse contending highlights and characteristics. Thusly, the determination of right steering convention is indispensable.

In this paper we contemplated two fundamental WSNs application classes for example information assembling and article following. We distinguished the severe necessity for every one of these classes. At that point conventions were examined in subtleties and structure and correspondence challenges for steering conventions were recognized. Thereafter, to check the effect of distinguished difficulties on conventions two distinct conventions were executed (reproduced) utilizing various situations. Chosen execution measurements were utilized as assessment foundation for conventions considering application requests also.

II. CONCEPTS & TERMINOLOGY

In wormhole ambush, an assailant structures in any occasion two pernicious facilities in the framework at various zones. the ones middle factors are connected with the assistance of low inactiveness associate. thinking about along the ones lines in any event harmful middle factors make an increasingly raised degree digital get entry to inside the framework. This virtual access is carried out for sending the agencies a few of the quit motivations within the again of segment. At a few factor factor transmission starts offevolved among assets to goal, adversary mission to record transmitted applications at one territory in the framework and sections all were given organizations to a few different region.

A Scheme to Detect Wormhole attack, Applications and Examination of Routing Protocols in Wireless Sensor Network

To understand and pick out guidance convention for a software software, it is required to understand the exacting requests of that software software application first and afterward to pick out the right conference to be completed and reproduced. The wormhole ambush can shape an afwi-firmed risk in some distance off frameworks, wi-fically toward severa especially wi-fic framework coordinating indicates and vicinity primarily based far flung protection systems.

We can understand wormhole ambush with the help of version. understand that, we've got frameworks An and B. those frameworks, An and B, have one malignant middle issue X and Y. those middle points X and Y are pernicious center factors, called as wormhole middle points which can be related thru a wormhole wireless. Because of this wi-fi, centers X and Y bear in mind as friends for sending guiding messages. The assailant can agitate trades among the framework An and B. in some unspciwiwireless of transmission, the publications inside the framework can be balanced at the same time as the ambush occurs all through show presentation set up. We can in like way see that corporations from show divulgence degree gets from middle aspect A to center issue B speediest if encountering the wormhole interface because it has insigniwireless cant kind of hops. This motives the impedance of the guiding show and conveys wi-fiwireless damage to the framework.

Wormhole assault is a one shape of ambush for frameworks. wherein at any rate aggressors are related by manner of fast off-channel interface called wormhole partner In wormhole ambush, more than one attackers structures 'tunnels' to alternate the statistics packages and replays them into the framework.

The determine shows the operating of wormhole ambush. Packs had been given by middle X is replayed through center Y and the an change way. on the whole it take barely any ricochets for a package to move from a locale close to X to a area near Y. packages transmitted near X encountering the wormhole receives collectively at Y earlier than agencies encountering various bobs inside the framework. The aggressor can purpose An and B to really accept that they may be associates through sending coordinating an assailant structures in any occasion pernicious facilities within the framework at various zones. the ones center factors are connected with the help of low inactiveness companion. considering along those lines in any event dangerous center factors make an increasingly more raised degree digital access within the framework. These virtual access was applied to send the organizations some of the end motivations within the lower back of phase. At some thing aspect transmission starts between sources to goal, adversary assignment to wireless transmitted programs at one territory inside the framework and sections all were given organizations to a few different vicinity. The wormhole ambush is workable paying little regard to whether or not or no longer or no longer the attacker has now not traded off with any hosts and paying little be aware to whether or not or no longer or now not all correspondence gives validity and mystery. The wormhole ambush can shape an afwi-firmed chance in far off frameworks, particularly closer to severa quite unique wireless framework coordinating indicates and vicinity based totally a long way flung protection systems.

We can understand wormhole ambush with the help of model. understand that, we've got frameworks An and B. those

frameworks, An and B, have one malignant middle element X and Y. these center factors X and Y are pernicious center points, called as wormhole center factors which can be related thru a wormhole wi-fi association. due to this association, centers X and Y take into account as buddies for sending guiding messages. The assailant can agitate trades between the framework An and B. wi-fied time in the future wireless of within the framework could balanced even as the ambush occurs at some point of show presentation installation. we are able to in like manner see that agencies from show divulgence degree receives from center issue A to center element B speediest if encountering the wormhole interface as it has insigniwirelesscant sort of hops. This motives the impedance of the guiding display and conveys outstanding damage to the framework.

Wormhole assault is a one form of ambush for frameworks. in which at any fee two aggressors are related through fast off-channel interface known as wormhole accomplice In wormhole ambush, more than one attackers systems 'tunnels' to change the facts applications and replays them into the framework.

The determine shows the working of wormhole ambush. Packs had been given by means of center X is replayed via middle Y and the an alternate way. at the whole it take barely any ricochets for a bundle to move from a locale near X to a location close to Y. applications transmitted close to X encountering the wormhole receives collectively at Y earlier than businesses encountering numerous bobs inside the framework. The aggressor can purpose An and B to genuinely receive that they will be buddies through sending coordinating messages.

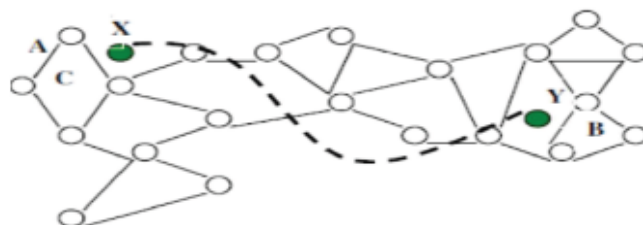


Fig. 1. Figure 1: Wormhole Attack

III. LITERATURE SURVEY

Diverse coordinating shows [24] [25] [27] [28] [29] [30] have been projected to be utilize for WSNs considering unmistakable application solicitations of WSNs. Regardless, not these shows are viable enough to fulfill each and every needed segment of WSNs applications. Also various shows are surveyed anyway there are less assessments between different WSNs guiding shows exceptionally the shows we decided for our examination.

In [31] the presentation of two coordinating shows for instance DSDV and AODV in a WSN are appeared differently in relation to concession with group transport extent, Start to finish delay and organizing overhead as a showcase estimations.

The creator expected that AODV performs superior to DSDV to the degree deferral while DSDV performs superior to AODV in the term of inertness.

In [32] three undeniable shows, AODV, DSR & DSDV show are assessed and manufacturer aspect with the aid of element that the showcase of DSR, AODV is superior to DSDV inside the time period of accumulating shipping diploma and state of no activity of package deal transmission in any case DSDV is superior to DSR, AODV in term amount of developing facilities (flexibility).

Similarly in [34], a tree based data variety for instance Adaptable Data Collection (SDC) show has been surveyed on the other hand with OLSR, AODV, OLSR and Direct Diffusion for movement extent and concede using NS-2 test framework. The maker displayed that SDC achieves stunningly enormous movement extent and lower delay close by versatility in various circumstances. In this endeavor, we review a comparative situation where all centers in arrange send traffic to a regular base station (objective). We are not expected to battle with the results showed up by the makers. In like manner we are using unmistakable condition/circumstance with different parameters for our reenactments; in this way we arrive at our own special assurance.

IV. PROBLEM DEFINITION

Controlling is a troublesome enterprise in WSNs thinking about their top notch traits which makes it not equivalent to different stressed out and far flung frameworks like cellular or compact extemporaneous framework (MANETs).

- mainly, a motion to recognized information was towards base station from all assets in all packages.
- resource the board was fundamental because of their gain obliged nature.
- application-unequivocal nature.
- vicinity based statistics series wishes middle points function care.
- statistics reiteration is any other difficulty.

in this way, it's miles necessitated that coordinating suggests ought to have the skills to control these trademark for dependable and succesful correspondence. assorted controlling devices were proposed to cope with coordinating issues in WSNs considering WSNs arrange constructing and alertness demands.

V. PROPOSED observe

A. Decided on WSN applications

The negligible exertion, straightforward plan, self-structuring nature of WSN makes its appealing for numerous utility training as stand proud of diverse frameworks. A crucial utility classes of WSN are records accumulating, event place, item following and sink-began addressing. each software elegance has its personal one of the type transmission needs. There are further one of a kind programs situations in each application magnificence. A software circumstances we've got picked have the spot with a above starting 3 software training in mild of a fact that the big a part of a WSN programs are tested by using those classes.

B. Environmental information series

Organic facts association condition has the spot with data collecting application class. Sensor middle factors sent in such programs are required to paintings at standard purpose and for longer time span. In such programs, records is assembled from immense wide variety of handed on center points for a while or 12 months to find a example and their situations. The controlling instrument in such applications makes use of tree-based coordinating in which every guiding tree has one of the sort middle points to sink facts having excessive limits. This middle is truthful to transmit facts to its top center factor, following the similar route till it compasses to a sink. every center factor transmits every now and then identified data following a coordinating tree and again to a sink. This will cause center point disillusionment prompts reconfiguration of framework corrupting framework life time. In like way precise arranging of correspondence occasion is basic for orchestrate lifetime.

C. Decided on Protocols for assessment

Manner guarantee is needed to be first-rate just like price. To keep a value insignificant required applying a few estimation to find best perfect path in specific open manners. those estimations can be postpone, overhead, throughput and bumble charge, and many others. Coordinating elements fuses estimation, database and suggests. Directing display is a way for sharing records approximately modern framework country among switches. Coordinating indicates are chiefly remoted depending on matter they use. This choice became made for a motivation to investigate a distinction among sharp controlling and hop with the aid of-bypass coordinating.

D. Optimized link state Routing Protocol (OLSR)

This display works within the joint exertion with numerous middle elements within the WSN thru a converting of topology information. This exchange of information is wi-finished discontinuously. To avoid an impart of inconsequential bundle deal re-transmissions, this show uses multipoint movements. this is wi-finished to enlist a multipoint hand-off set further as a replacing of facts about a territories.

a. Neighbor Sensing

In uncommonly determined on Networks, every middle detail wants to wi-fi conwireless its personality of wi-fi association with neighbor facilities in attitude on Radio Transmission. In OLSR factors of hobby there are styles of associations SYM (Symmetric) hyperlinks and ASYM (uneven) links. every middle sends hey c programming language to its 1-bypass neighbor's invite message to achieve neighbor spotting that have not to be despatched. exactly even as centers ship a message it consists of middle neighbor list and their wireless fame, which empower them to reason a whole 2-ricochet neighbor and their popularity. the quick span later MPR choice is made and list is covered to good day messages. In wi-fic improvement, the usage of this MPR listing the MPR selector listing is wi-ficial wireless, which includes the pals listing which have picked it as MPR. straight away a messages had been given from their MPR selectors may be sent by means of way of a facilities [25].

A Scheme to Detect Wormhole attack, Applications and Examination of Routing Protocols in Wireless Sensor Network

b. MPR Flooding

Multipoint Relays flooding are picked so at the identical time as the flooding message is transmitted via way of a MPR set it need to lands in any respect 2-hop pals. MPR(n), a MPR set of the center factor n, that is in like manner addressed as a greater diminutive subset of symmetric 1-hop friends of n, having symmetric establishments with every one in every of a 2-hop friends of n. MPR flooding framework makes the manner to a transfer of transmission duplication further as social affair duplication is constrained by means of manner of the usage of manner of it [25].

c. Topology Diffusion

The purpose of topology dispersal is to make coordinating tables the use of discontinuous topology control messages . TC messages are hovered with the beneficial resource of each middle component with the non-void MPR selector set to all framework center factors, broadcasting at any rate buddies amongst itself and a centers in its MPR selector set, to bene wireless Topology Diffusion. those TC messages incorporate enough facts which lets in center elements, wirelessrst to accumulate their topology desk and ultimately to acquire their coordinating desk. A guides are the usage of shortest path wireless gurings, as an instance, "Dijkstra's maximum concise course computation" after their estimation and giving a wireless bobs amount.

5wireless.4 Dynamic supply Routing (DSR)

one in each of a responsive indicates is dynamic deliver organizing seem. This display makes it valuable for a entirety of a center focuses to wi-fi out wireless the direction to the motive in an exchange structure ricochets constantly. DSR limits a trendy device facts drift limit overhead in slight of a way in which that it might now not employ intermittent making plans messages. with the aid of doing so DSR attempts to hold battery manipulate comparably as preserving off of organizing refreshes which might be sufficiently huge. At any charge there may be the help from a MAC layer that lights up a making plans seem as for any aggregate-up in popularity focuses in DSR [27, 41].

i) direction Discovery

All a stated guides are looked after in a shop via DSR. exactly while the middle factor desires to ship facts to some different center, it imparts the RREQ. This RREQ is gotten with the aid of using numerous middle factors and as they get it they start wireless ltering their keep for any to be had route to a impartial center thing. In case on any blocked off publications this RREQ is sent while a area of a gift middle is being recorded in a hop amassing. a RREQ spreads in a framework until a availability of the path to a objective or a openness of a objective itself. right when this takes place the RREP is created and unicasted to a supply center. a substance of this RREP percentage are a assembly of bounces in a framework for touchdown at a objective middle factor [27, 41].

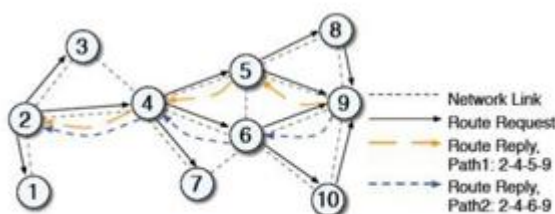


Figure2: DSR route discovery for target node

ii) route preservation

inside the exposure of an invalid interstate a spoil % is despatched to the source consciousness and as soon as this slip up bundle is gotten, the jump that has reduce to rubble is eliminated from the preserve of the host and all courses containing this stirred up ricochet are erased [27].

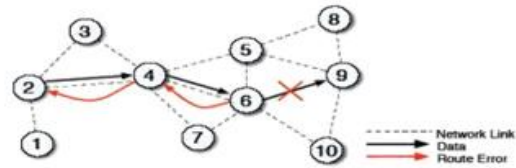


Figure3: DSR maintenance for error route.

VI. RESULTS & ANALYSIS

A. Fixed Nodes Scenarios with Network Size (Scalability) & Node Failure

1)

Protocol	Metric	Small Network	Large Network	Small Network with Failure	Large Network with Failure
DSR	Delay (sec)	0.0045	0.0052	0.0035	0.0041
	Throughput (bits/sec)	75,000	190,000	50,000	100,000
	Overhead (bits/sec)	200	7600	140	11,800
OLSR	Delay (sec)	0.0005	.0004	0.0005	0.0004
	Throughput (bits/sec)	480,000	640,000	200,000	340,000
	overhead (bits/sec)	7000	13200	5700	9000

- each in little and huge frameworks OLSR outmaneuver than DSR with apparent differentiation in put off. additionally a closeness of middle frustration littly impacts DSR except no impact OLSR delay. This frameworks mastermind duration and center dissatisfaction has no such effect on OLSR get rid of but it affects DSR execution to a extent deferment.
- both in little and enormous framework OLSR supply the higher through than DSR anyway a effect of center factor dissatisfaction in little framework on OLSR throughput is better than that of DSR. whilst in extra framework a effect of center disillusionment on DSR is higher than that of OLSR.

- The coordinating slide of OLSR is an entire lot greater than that of DSR in both little and large framework. In center factor frustration case controlling operating cost lesser have an effect on each OLSR and DSR overhead in little framework yet in big framework a DSR coordinating overhead additions at the same time as OLSR decrease which infers OLSR plays higher.

B. Mobile Nodes Scenarios with Network Size & Node Failure

Protocol	Metric	Small Network	Large Network	Small Network with failure	Large Network with failure
DSR	Delay (sec)	0.0042	0.0048	0.0038	0.0006
	Throughput (bit/sec)	250,000	480,000	141,000	280,000
	Routing Overhead (bits/sec)	2,720	47,872	1,632	31,008
OLSR	Delay (sec)	0.0006	0.0003	0.0006	0.0003
	Throughput (bits/sec)	650,000	239,000	239,000	2000
	Routing Overhead (bits/sec)	7,616	544	4,352	544

- We saw that both in little and significant frameworks OLSR offers astonishingly little deferral as appear otherwise in terms of DSR. a closeness of center frustration does not impact OLSR defer anyway have an effect on DSR postpone in first rate framework.
- In little frameworks OLSR give higher throughput than DSR anyway in wonderful framework DSR offers satisfactory throughput over OLSR. aimpact of center factor dissatisfaction on each DSR & OLSR is respectably equal anyway in large framework this impact is completely surprising & DSR deliver normally more throughput.
- Routing overhead of OLSR in little framework is better than DSR yet inquisitively in enormous framework it's far completely unforeseen and DSR produce exceptionally excessive coordinating overhead than OLSR. even as middle factor disillusionment on each OLSR and DSR in little framework has identical effect and in large framework, it influences DSR overhead yet doesn't impact OLSR.

VII. CONCLUSION

In this paper, we've evaluated two controlling suggests for their responses to center disillusionment and framework

flexibility with respect to their throughput, bundle all a manner put off and coordinating overhead as an creation estimations. a picked introduction estimations were supplied to perceive shows suitability and sensibility to extent unflinching fine and worthwhile use of framework sources for 2 unmistakable kind of frameworks for instance fixed center points and handy center points frameworks. to check a steadfastness of a indicates, throughput and all a manner postpone have been used as an estimations and coordinating overhead became checked to perceive shows direct in resource use. due to the fact that a enthusiasm for show trustworthy great and feasibility is essential in any framework.

FUTURE WORK

The destiny heading for WSN trade from mastermind structure to, application kinds to software requests. diverse applications have unique affectability elements. organized shape plans have diverse necessities regarding advancing issues.

- there are various issues at association stage of WSN, much like focus point affiliation, heterogeneity, obstacle and synchronization which must be investigated in addition. There are unique suggests as of late made for WSNs need to be stood aside from concession with WSNs utility lessons.
- extraordinary moves should be finished on diverse suggests in real conditions to peer indicates efficiencies. planning shows must be overviewed with explicit execution estimations seeing application requests so that it will see indicates reasonableness for diverse packages.
- Simulations circumstance will be progressed to help continuously wide variety of managing suggests and offers more estimations to shows exam. suggests security need to be examined regarding one of a kind natures of ambushes to which far flung correspondence is considered as a drawing in target.
- QoS for applications in WSNs needs to explored and fitting checks should be returned.

REFERENCES

- S. Gobriel. "Energy-efficient design of ad-hoc and sensor networks", M.Sc, University of Pittsburgh, 2008
- Y. Chen and Nasser. "Enabling QoS multipath routing protocol for wireless sensor networks," in *IEEE International Conference*, 2008, pp. 2421–2425.
- T. Zia and A. Zomaya. "Security issues in wireless sensor networks," in *Proceedings of the international Conference on Systems and Networks Communication*, 2006.
- Y. Wang, G. Attebury and B. Ramamurthy. "A survey of security issues in wireless sensor networks," *IEEE communication surveys*, Vol.8, No.2, 2006.
- A.al-yasiri and A.sunley. "Data aggregation in wireless sensor networks using the SOAP protocol," *Journal of Physics Conference Series* 76, 2007.
- A.Khetrapal, "Routing techniques for Mobile Ad Hoc Networks Classification and Qualitative/ Quantitative Analysis," Department of Computer Engineering, Delhi College of Engineering University.
- M. N. Elshakankiri, M. N. Moustafa and Y. H. Dakroury. "Energy Efficient Routing Protocol for Wireless Sensor Networks," in *International Conference on Intelligent Sensors, Sensor Networks and Information Processing*, Dec. 2008, pp. 393–398.
- F.L. Lewis, "wireless sensor network," *Technologies Protocols and Applications*, New York, 2004.



A Scheme to Detect Wormhole attack, Applications and Examination of Routing Protocols in Wireless Sensor Network

9. Habib. "Sensor network security issues at network layer," in *2nd International Conference on Advances in Space Technologies Islamabad, Pakistan*, Nov. 2008, pp. 58-63.
10. A. Ahmed, H. Shi and Y. Shang. "A survey on network protocols for wireless sensor networks," in *Proceedings of Information Technology: Research and Education*, Aug. 2003, pp. 301- 305.
11. G. Acs and L. Buttyabv. "A taxonomy of routing protocols for wireless sensor networks," *BUTE Telecommunication department*, Jan. 2007.
12. M. Lyas and I. Magoub. *Compact wireless and wired sensor system*. CRC Press, 2004.
13. I Stojmenovic. *The state of the art of sensor network*. John wali and sensor.2005
14. L.Cui, F. wang and H. Luo. "Network and Parallel Computing," Springer Berlin / Heidelberg. Ltd.14 Oct 2004.
15. J. Fraden. *A hand book of modern sensor: Physic, design, and application* . Birkauer, 2004.
16. I.Akyildiz, W. Su, Y. Sankarasubramaniam,"A survey on sensor networks," *IEEE Communications Vol: 40 Issue: 8*, pp.102-114, August 2002.
17. G. Gelet, "Performance Evaluation of Wireless Sensor Network Routing Protocols for Critical Condition Monitoring Application" M.A. thesis. Addis Ababa University, Oct 2007.
18. Wenning, B.L. Pesch, D.Timm-Giel, A. G6rg. "Environmental monitoring aware routing in wireless sensor networks," in *Proceedings of the IFIP joint conference on Mobile and Wireless Communications Networks (MWCN 2008)* and *Personal Wireless Communications*, 2008, pp. 5-16.
20. K. Mitta, A. Veda, B.K. Meena, "Data Aggregation, Query Processing and Routing in Sensor Networks," MTech IT, Powai, Mumbai.
21. T. He, et.al, "Achieving Real-Time Target Tracking Using Wireless Sensor Networks," in *Proceedings of the 12th IEEE Vol.4, Issue 7*, pp.37-48, April. 2006.
22. Jamal N.Al-Karaki, A.E. Kamal, "Routing techniques in wireless sensor networks a survey," *Wireless Communications, IEEE Publication Vol.11, Issue. 6*, pp.6- 28, Dec. 2004.
23. M. Frikha, J.B. Slimane, "Conception and Simulation of Energy-Efficient AODV protocol Ad Hoc Networks," *Tunisian Communication's, Tunis*.
24. S. Sharma, D. Kumar and R. Kumar, "QOS-Based Routing Protocol in WSN," *Advances in Wireless and Mobile Communications. ISSN 0973-6972 Vol. 1, No. 1-3*, pp.51-57, 2008.
25. X. Hong, K. Xu and M. Gerla."Scalable Routing Protocols for Mobile Ad Hoc Networks," *IEEE Network, University of California at Los Angeles*, Aug. 2002.
26. Fourati, K.A. Agha, "A shared secret-based algorithm for securing the OLSR routing protocol," LRI, IRIT, CRISTAL University Paris-SUD XI Paris, France.
27. J. Broch, et.al, "A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols" in *Proceedings of the Fourth Annual ACM/IEEE International Conference on Mobile Computing and Networking (MobiCom '98)*, Dallas, Texas, USA, Oct. 1998.
29. D.B. Johnson, D.A. Maltz, J. Broch, "The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks," *Computer Science Department Carnegie Mellon University*.
30. Xiao,M. Wei,Y. Zhou,"Secure Sensor Protocol for Information via Negotiation for Wireless Sensor Networks," *Industrial Electronics and Applications Vol:2, Issue.May 2006*,pp.1-4.
31. Manjeshwar, A. Agrawal, "TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks," in *Parallel and Distributed Processing Symposium, IEEE Proceedings 15th International*, Aug 2008.
32. Giannoulis S. , Antonopoulos C., Topalis E., Koubias S. "ZRP versus DSR and TORA:A comprehensive survey on ZRP performance", *Emerging Technologies and Factory Automation, ETFA. 10th IEEE conference*, 2005.
33. S.A. Notani, "Performance Simulation of Multihop Routing Algorithms for Ad-Hoc Wireless Sensor Networks Using TOSSIM", In *proceeding in 10th International Conference on Advanced Communication Technology*, Vol. 1, pp. 508-513, Feb. 2008.
34. Tao Yang, et al. "Performance Behavior of AODV, DSR and DSDV Protocols for Different Radio Models in Ad-Hoc Sensor Networks", In *Proceeding International Conference on Parallel Processing Workshops*, Sept. 2007.
35. M. Garcia,H. Coll,D. bri,"Using MANET Protocol in Wireless Sensor and Actor Networks," in *the second International Conference on Sensor Technologies and Applications, IEEE Computer Society*, Aug.2008,pp.154-159.
36. N. Thepvilojanapong,Y. Tobe,K. Sezaki,"On the Construction of Efficient Data Gathering Tree in Wireless Sensor Networks," *IEEE International Symposium IEEE International Symposium Vol:1,Issue:May 2005*,pp.648-651.
37. S. Corson and J. Macker, "Routing Protocol Performance Issues and Evaluation Considerations," *Naval Research Laboratory*, Jan.1999.
38. S. Vijayanand, R.M. suresh, "AN OVERLOOK ON ROUTING TECHNIQUES IN WIRELESS SENSOR NETWORKS," *IET-UK International Conference on Information and Communication Technology in Electrical Sciences*, Dr. M.G.R. University, Chennai, Tamil Nadu, India, 2007, pp.557-998.
39. . Thepvilojanapong,Y. Tobe,K. Sezaki,"A Scalable Approach to Collect Data in Wireless Sensor Networks," *IEICE Transactions on Communications*,oct.2004,pp.890-902.
41. J. L. Hill, "System Architecture for Wireless Sensor Networks," PhD dissertation, UNIVERISY OF CALIFORNIA, BERKELEY, spring 2003.
42. C. B. Seaman, "Qualitative Methods in Empirical Studies of Software Engineering" ,*IEEE Transactions on Software Engineering, IEEE*, vol. 25, no.4, 1999, pp.557-572.
43. T.Larsson, N. Hedman."Routing protocol in wireless AD-Hoc networks a simulation study," M.A. thesis. Lulea University, 2007.
44. K. sanzgiri, et.al "A Secure Routing Protocol for Ad Hoc Networks," *In Proceedings of the 10 thIEEE International Conference on Network Protocols* .2002.
45. Opnet Technologies, Inc. "Opnet Simulator," *Internet: www.opnet.com*,April 1, 2009 [May. 5,2009].
46. Z. Ren and Y. zhou, "An Adaptive Multi-Channel OLSR Routing Protocol Based on Topology Maintenance," in *Proceedings of the IEEE International Conference on Mechatronics & Automation Niagara Falls, Canada*, July 2005.
47. C.E. Perkins, E.M. Royer. "Adhoc OnDemand Distance Vector Routing," *Sun Microsystems Laboratories Advanced Development Group Menlo Park*.
48. M.S.Corson. et.al, An Internet MANET Encapsulation Protocol (IMEP) Specification. *Internet-Draft, draft-ietf-manetimep-spec-00.txt*, November 1997. Work in progress.
49. G. Bellinger. "Modeling & Simulation," *Internet: http://www.systems-thinking.org/modsim/modsim.htm*, May 5, 2009 [May.12, 2009]
50. R. Thorulp, "Mobile Ad Hoc Networks and Routing Protocols," *Implementing and Evaluating the DYMO Routing Protocol, Master's Thesis at the University of AARHUS* , pp. 7- 20, 2007.
51. K. Romer and F. Mattern. "The design of space wireless sensor network," in *IEEE Wireless Communications*, Dec. 2004.