

**University of Science and Technology**  
**College of Post Graduate Studies and**  
**Academic Advancement**

Thesis submitted in Partial Fulfillment of the Requirements  
for the Degree of Master of Computer Sciences

**A Dynamic Threshold for Watchdog Detection  
Technique Against AODV MANETs Black Hole  
Attack**

By:

Alsawi Mohammed Ahmed Mohammed Abbas

Supervisor:

Dr. Noureldien Abdelrhman Noureldien

December - 2014

## Abstract

A mobile ad-hoc networks (MANETs) are composed of equivalent nodes that communicate over wireless links without any central control. And can move randomly. MANETs have no network infrastructure, and are used in many areas because the ease and speed of deployment.

The nodes can cooperate to communicate with each other by sending data packets from source to destination node through the intermediate node(s) by using routing MANETs protocols such as AODV which is the most popular routing protocol. have limited resources and several vulnerabilities, so mobile ad-hoc networks are defenseless to attacks done by some of the malicious nodes.

These attacks can prevent the transmission or reduce the performance of the network. One of these attacks is the Black Hole Attack in which one or more malicious nodes sucking all the data in the network. As a result the data packets do not reach the destination node and the data will be lost.

Many black hole detection and prevention techniques have been proposed, such as neighborhood-based method, path based method, BDSR scheme, sequence number scheme and watchdog.

So the security is essential for such kind of networks, there are many of detection and prevention mechanisms to eliminate the black hole attack. In this research, we proposed and simulate an improvement in one of the techniques used to detect the black hole attack in MANETS called watchdog to resolve the hidden node problem found in this technique and the results represented to reflect the better performance. In this research a dynamic threshold calculation for watchdog detection technique is proposed. The simulation results show that show that the threshold can be obtained dynamically depend on the network overload.

## المستخلص

تتألف شبكات المحمول الخاصة من عقد متكافئة تتصل عبر شبكة لاسلكية ليس لديها بنية تحتية دون اي تحكم مركزي . ويمكن لجميع العقد التحرك بشكل عشوائي ، والتي يمكن استخدامها في عديد من المجالات بسبب سهولة وسرعة انتشارها .

يمكن للعقد التعاون للتواصل مع بعضها البعض عن طريق إرسال حزم البيانات من المصدر إلى المستقبل وذلك عبر عقده او مجموعة عقد وسيطه باستخدام أحد بروتوكولات التوجيه وعلى سبيل المثال بروتوكول AODV والذي يعتبر من اشهر بروتوكولات التوجيه. كما أن موارد هذه الشبكات محدوده وبها العديد من نقاط الضعف مما يجعل منها غير قادرة على التصدي لبعض إختراقات العقد الخبيثة. هذه الهجمات من الممكن ان تمنع عملية نقل البيانات او تقلل من أداء الشبكة، أحد هذه الهجمات هو الفجوة السوداء والذي يعمل على إمتصاص جميع البيانات المرسله عبر الشبكة ، ونتيجه ذلك عدم وصول البيانات الى وجهاتها وبذلك تفقد البيانات.

ولذلك فإن الأمن هو ضرورة لهذه الشبكات ، وهناك العديد من الآليات المستخدمة لإكتشاف وجود هذا الهجوم مثل إستخدام معلومات عن العقد المجاورة، أسلوب الكشف بإستخدام المسار، طريقة BDSR ، طريقة رقم التسلسل و طريقة إستخدام كلاب المراقبة.

في هذا البحث قمنا بإقتراح طريقة ديناميكية لحساب عدد الحزم المستخدم كحد أعلى في إحدى التقنيات المستخدمة للكشف عن وجود هذا الهجوم في هذا النوع من الشبكات. أثبتت النتائج أن من الممكن حساب عدد الحزم بطريقة ديناميكية بناء على نشاط العقدة في الشبكة بدلا عن الطريقة التقليدية التي لا تأخذ حجم الضغط على الشبكة في عين الإعتبار.

## **1.1 Introduction**

MANET's (Mobile Ad-hock Networks) have capability to self-manage without any need to predefined infrastructure. In addition MANET's give their members nodes another feature namely the freedom of rooming that is all nodes in MANET's will be unrestricted to be in specific location in the network. MANET's can be applicable in many potential areas when it is not possible to set up a fixed infrastructure like: Military environments, Emergency operations, Civilian environments and Personal area networking.

To make the connection between the MANET's nodes in the absence of centralization the nodes act as host and router as well, to supports this kind of connectivity new routing protocols are developed like: AODV (Ad-hock On-demand Distance Vector, DSDV (Destination-Sequenced Distance-Vector), OLSR (Optimize Link state Routing) and DSR (Dynamic Source Routing).

MANET's facing many security challenges that inherit from wireless transmission media which is used as a link between nodes and the highly dynamic topology. The use of wireless transmission media make MANET's exposed to a many types of attacks that targets a confidentiality of data such as IP-spoofing, on the other hand the highly dynamic topology make implementation of some of traditional security mechanism difficult.

Generally MANET's suffer from many security problems which are make them grainy environment to many types of attack. Examples of Manet's attacks include black-hole attack in which the malicious node drops all data packets instead of forwarding them to its destination thereby using routing discovery mechanism as weak point in the routing protocol.

## **1.2 Research Problem**

There are many black hole detection techniques that were proposed to make MANET's able to defend against black-hole attack. Most of these proposed solutions have many drawbacks. Developing an efficient detection technique for black hole attack is an active area.

## **1.3 Research Objectives**

The main objective of this research is to investigate the current black hole attack detection techniques in order to develop a dynamic calculation mechanism of threshold that used in watchdog detection technique in order to improve this technique.

## **1.4 Research methodology**

In this research we use an analytical approach to understand MANET's vulnerabilities and how can be exploited by many types of attacks and especially by black-hole attack. A deep analysis of black hole attack is carried out. Practical approach to improve the watchdog black-hole detection method complements the analytical approach.

## **1.5 Results**

In this study an improvement in the watchdog detection technique against black-hole attack has been proposed for AODV routing protocol in MANETs.

The comparative results from implements the traditional watchdog technique that uses a constant threshold and improved one show that, the improved detection technique consider the collision probability and can calculate dynamic threshold instead of the static way used to identify black holes which lead to false alarms caused from the hidden node problem.

## **1.6 Thesis Organization**

The rest of this thesis is organized as follows: chapter 2 surveys MANET's attacks, chapter 3 details black hole attack, chapter 4 is dedicated to current watchdog detection technique and the proposed improvement and finally conclusion and future work is given in chapter 5.