Design and Analysis WLAN Nodes Performance Based on Roaming Technique

Khalil I. Alsaif
Mosul University
Computer Science Dept.
Khalil_alsaif@hotmail.com
Ibrahim A. Saleh
Mosul University Software Eng. Dept
Omar I. Alsaif
Technical Institute /Mosul

Abstract

The advent of portable computers and wireless networking has lead to large growth in the data analytic due to the inherent flexibility offered. Most wireless networks are built around an infrastructure, where all communications is routed through base stations that act as gateways between the wireless and wired network. However, there may be situations in which it is impossible or not desirable to construct such an infrastructure.

In this research roaming technique in the wireless local area network were investigated, however an scenario of two sub network including two access points and the distance between them (2000m), where the first sub network contained one access point and eight work station mobile while the second sub network contains one access point and four work station mobile. To record computers roaming from one sub network to other and vice versa two work stations would be operates as traffic destined.

The proposed scenario analysed (using opnet modeler 14 software) by transferring first sub netwok computers group to the second one, the data traffic reduced till zero at the first access point after 25 second, which represent the time required to leave the last computers and rested at second sub network location, further more data traffic will be increased and doubled at second access point after roaming operation accomplished.

In the second period of the scenario, all computers of second sub network will be roamed to the first one location to study roaming operation effects to all individual components network.

Keywords: Wireless LAN, Node Performance, Roaming Technique, Mobile Station.

خليل ابراهيم السيف
كلية علوم الحاسوب والرياضيات / قسم علوم الحاسوب
ابراهيم احمد صالح
كلية علوم الحاسوب والرياضيات / قسم هندسة البرمجيات
عمر ابراهيم السيف
المعهد التقني بالموصل / قسم انظمة الحاسوب

الملخص

ان ظهور الحواسيب المحمولة والشبكات اللاسلكية قد ادى إلى نمو كبير في مجال تحليل البيانات بسبب ما قدمته من مرونة كبيرة. ان بناء معظم الشبكات اللاسلكية يتم في جميع أنحاء البنية التحتية، حيث يتم توجيه جميع الاتصالات من خلال محطات اساسية تعد بمثابة بوابات بين الشبكة السلكية واللاسلكية .ومع ذلك، قد يكون هناك حالات يستحيل أو يكون من غير المرغوب فيها بناء مثل هذه البنية التحتية. تم في هذا البحث دراسة تقنية الانتقال (Roaming) في الشبكات الموقعية المحلية اللاسلكية (Wire Less Local Area Networks)، اذ تم تصميم سيناريو يتكون

من شبكتين فرعيتين (Two Sub network) تحتويان على نقطتي وصول (Access Point) المسافة الفاصلة بينهما بحدود (2000 m)، تتكون الشبكة الفرعية الاولى من نقطة وصول وثمان محطات عمل قابلة للحركة (Work Station Mobile) بينما تتكون الشبكة الفرعية الثانية من نقطة وصول واربع محطات عمل فقط. تضمنت الشبكة الفرعية الثانية محطتي عمل تعملان على شكل (Traffic Destined) لاجل تسجيل انتقال الحاسبات من شبكة فرعية الى اخرى وبالعكس. تم اجراء عملية تحليل السيناريو المقترح باستخدام برنامج (Opnet Modeler 14) وذلك بانتقال مجموعة حاسبات الشبكة الفرعية الاولى الى موقع عمل الشبكة الفرعية الثانيه، حيث تبين ان ازدحام البيانات يقل عند نقطة الوصول الاولى حتى يصل الى الصفر بعد مرور (25 ثانية) على مغادرة اخر حاسبة واستقرارها في موقع عمل الشبكة الفرعية الثانيه، اضافه الى ازدياد في ازدحام البيانات (Data Traffic) في نقطة الدخول الثانيه ليتضاعف عند اكتمال عملية الانتقال. في المرحلة الثانية من السيناريو سيتم نقل جميع الحاسبات من الشبكة الفرعية الثانيه الى موقع الشبكة الفرعية الاولى حيث تم دراسة تأثير عملية الانتقال على مفردات الشبكة بالكامل.

1. INTRODUCTION

The use of wireless LAN (WLAN) systems is rapidly growing in the communications industry. As the demand for WLAN products is increasing, it is becoming vital to understand the relevant performance aspects.

WLANs can be used either to replace wired LANs or as an extension of the wired LAN infrastructure. The basic topology of the network consists of two or more wireless nodes or stations that have recognized each other and established communications.

In the most basic form, stations communicate directly with each other on a peer-to-peer level, sharing a given cell coverage area. This type of network is often formed on a temporary basis and is commonly referred to as an ad hoc network or independent basic service set (IBSS). In most cases, the basic service set (BSS) contains an access point (AP). The main function of an AP is to form a bridge between wireless and wired LANs. The AP is analogous to the base station used in cellular phone networks. When an AP is present, stations do not communicate on a peer-to-peer basis[1].

All communications between stations or between a station and a wired network client go through the AP. APs are not mobile and form part of the wired network infrastructure. A BSS in this configuration is said to be operating in the infrastructure mode. The popular physical (PHY) layer and medium access control (MAC) sub layer standard for WLAN are provided by the Institute of Electrical and Electronics Engineers (IEEE) in the form of a family of 802.11 protocols. The basic access method for 802.11 is the Distributed Coordination Function (DCF), which uses Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA).

Roaming is another issue that gateways can address. Roaming users may move out of range of their current access point and into range of several alternative access points. Handover delays may affect streaming applications like Voice-over-IP (VoIP) and video. Secure access points might require the user to be re-authenticated, while gateways offer other options. The 802.11 Fast Roaming Study Group and 802.21 working group are looking for standard ways to address roaming[1]-[9].

2. 802.11 Protocol Architecture

The 802.11 standard allows both infrastructure networks, which are connected to a wired network (typically Ethernet) using an access point, and independent networks connecting peer computers wirelessly with no wired network present. Most installations are of the infrastructure variety, and we focus on them. From the point of view of the Ethernet network, which is usually connected to both ends of an 802.11 link, the wireless

link is just another way of moving an Ethernet packet, formally known as a frame, from one station to another. The stations associated to a particular access point constitute a basic service set (BSS).The collection of BSSs connected to a single wired network forms an extended service set (ESS) (Figure 1). A BSS has a unique identifier, the BSSID. An ESS also has an identifier, the ESSID, that is unique to that ESS but shared by all the component BSSs [2].

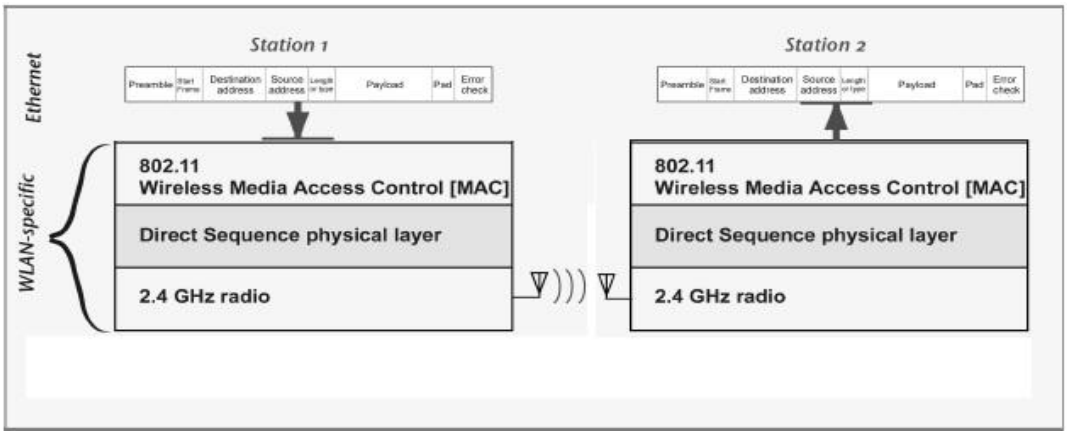

Figure (1) WLAN - specification

Unfortunately, interfaces for many commercial 802.11 implementations use the nomenclature SSID, which in practice usually refers to the SSID but is obviously somewhat ambiguous and potentially confusing. The ESS architecture provides a framework in which to deal with the problem of mobile stations roaming from one BSS to another in the same ESS. It would obviously be nice if a mobile station could be carried from the coverage area of one access point (i.e., one BSS) to that of another without having to go through a laborious process of reauthenticating, or worse, obtaining a new Internet protocol (IP) address; ideally, data transfers could continue seamlessly as the user moved.

A distribution system is assigned responsibility for keeping track of which stations are in which BSSs and routing their packets appropriately. However, the original and enhanced 802.11standards did not specify how such roaming ought to be conducted; only with the release of the 802.11f Inter-Access Point Protocol (IAPP) standard in 2003 did the operation of the distribution system receive a nonproprietary specification. The IAPP protocol uses the nearly universal internet protocol (TCP/IP) combined with RADIUS servers to provide secure communication between access points, so that moving clients can reassociate and expect to receive forwarded packets from the distribution system[2].

3. Differences Between Portability and Mobility

Portability certainly results in a net productivity gain because users can access information resources wherever it is convenient to do so. At the core, however, portability removes only the physical barriers to connectivity. It is easy to carry a laptop between several locations, so people do. But portability does not change the ritual of connecting to networks at each new location. It is still necessary to physically connect to the network and reestablish network connections, and network connections cannot be used while the device is being moved [7]

Mobility, on the other hand, is a far more powerful concept: it removes further barriers, most of which are based on the logical network architecture. Network connections stay active even while the device is in motion. This is critical for tasks requiring persistent, long-lived connections, which may be found in database applications[8].

4. Software Modeling Using Opnet Modeler 14.

This scenario is built to demonstrate some of the implemented features of the WLAN technology specified in IEEE's 802.11, 802.11a, 802.11b, 802.11g, 802.11e and 802.11f standers using OPNET WLAN model like roaming of mobile WLAN nodes among two access points.

Since this OPNET modeler is comprehensive software designed for to study communication network protocol and other applications, we propose this modeler for studying roaming technique in wireless mobile networks. The OPNET modeler supports, point to point, bus and radio links. The OPNET modeler environment allows user to simulate the models as they have created in dynamic scenarios in order to study system behavior and performances e. g. flow of data, basic statistics and behavioral data[3] - [6].

5.Scenario components

This scenario highlights the roaming capabilities in WLAN nodes models among available access points. The network consists of (16) mobile work stations, among those two of them configured as access point, AP (A) and AP (B), since two access points not connected to each other to verify roaming functionality[4].

In this case, two mobile station can makes connection with each other only when they are in the Basic Service Set (BSS) of the same access point. The left side contain eight nodes (A1 to A8) and one access point, while right side include four nodes, one access point and two station operate as traffic destination (dest. A, dest. B) to indicates the moving of nodes from left side to the right and vice versa. Figure (2) illustrate the network topology of the suggested scenario.

Roaming functionality is enabled on the all stations that are not access points [4]-[5].

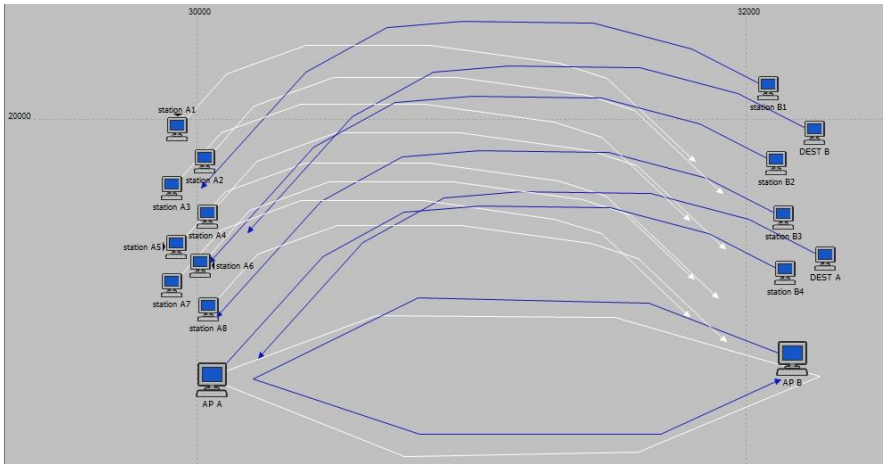

Figure (2) Network topology of the suggested scenario

6. Stations Movement and Results

When the stations stays at their initial locations, the traffic generated by the left side stations cant reach's its destination (dest. A), because the source and destination are connected to different access points. The eight Stations in the left side start their trajectory at time (10 sec) and reach right side at (40 sec), they reaches access point B one by one, so they will be use roaming technique to be served by (AP B) instead of (AP A), as displayed in figure (3).

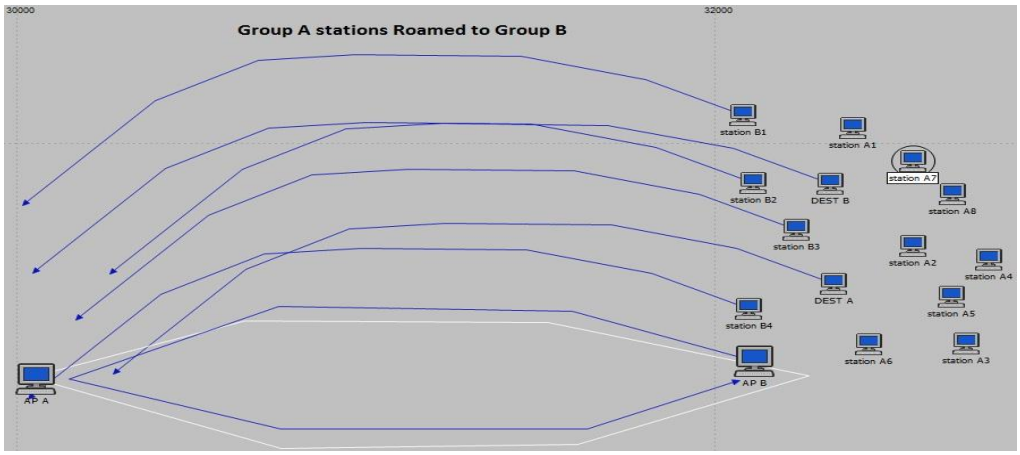

Figure (3) Explain first roaming operation (group A to group B)

After this movement (AP A) received data traffic drops to zero around (35 sec), which represent the time needed to be served by (AP B), and this clear in the throughput rate in access point (A), as illustrate in the figure (4).

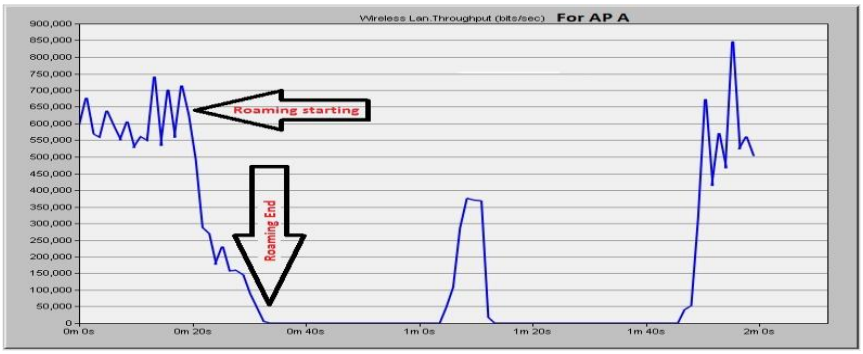

Figure (4) Represent throughput in (AP A)

Roaming operation supposed to start at time (10 sec), but the network will be effected really at time around (20 sec), because type of station movement (one by one).The wireless lan throughput decreased gradually till reached to zero at time round (35 sec). Table (1) shows time against throughput in access point (A) for first (40 sec.).

Table (1). Time verses throughput in access point (A) for first (40 sec.).

Time (Second)	Throughput (bit/sec)
5	625.000
10	525.000
15	570.000
20	500.000
25	175.000
30	100.000
35 – 65	0.000

Another diagram could use as a good indicator for roaming operation is (data traffic received) at access point (A), where this traffic has large amount when all station in their initial location, then it will be decreased at the beginning of roaming operation until reached zero when last station from group A will connect to access point B, as in figure (5).

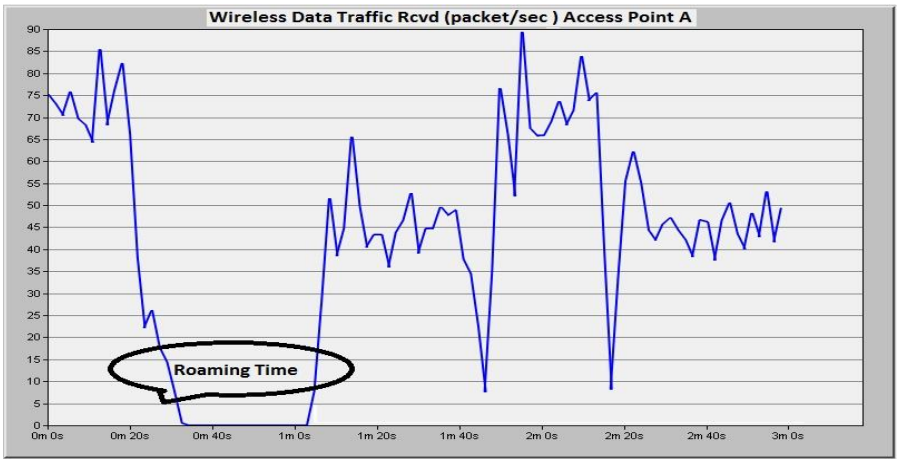

Figure (5) Data traffic received by access point (A)

Destination traffic (A) will receave average data around (750,000 bits/sec.) before roaming operation and will be increased until reached maximum value (1,600,000 bits/sec.) at time around (28 sec).This gradually increasing in data can be explained as:

1- Dest (A) before roaming operation was record data of group (B) stations.

2- Roaming operation doesn't happen suddenly but one by one station so this period (15 to 28 sec.) is transient period where the stations are searching for available

access point in the new region and evaluating ones they find, during which the data transmission is suspended, as showed in Figure (6).

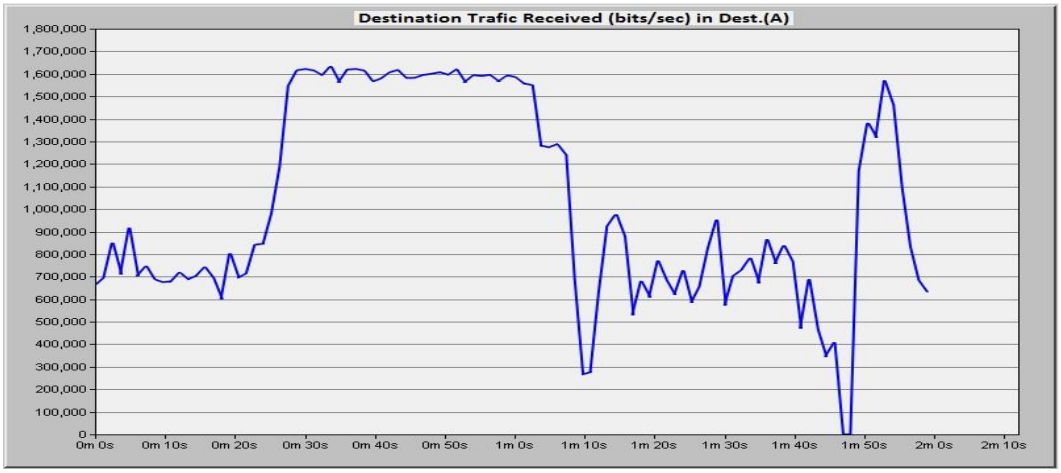

Figure (6) Explain data traffic received in Dest. (A).

7.Second Stage of the project

In the second stage of this project, four stations in group B (B1 to B4) will be roamed from right side to left one. This stage start at time (50 sec.) and finished at (80 sec.). Hence they leave BSS of access point (B) to connect to access point (A). This is can be seen in the results since the traffic received by access point (A) increased sharply while the received traffic at access point (B) decreased, as shown in the figure (7).

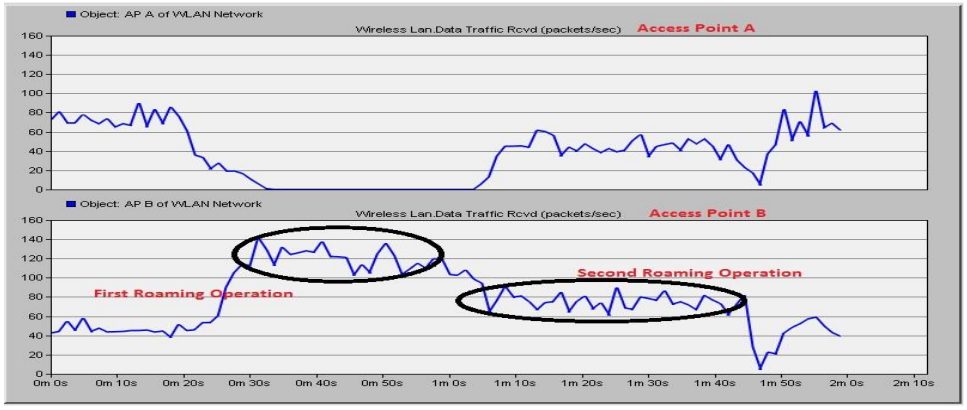

Figure (7) Explain traffic received in the two access points (A, B)

8. Results Discussion and conclusions

In this paper wireless lan nodes designed and analyzed to evaluate an important parameters that effects on roaming technique and can be used as good indicators like throughput in access points in the network beside data traffic received from destination traffic in both groups (A, B). The results showed that there are increasing in data traffic toward moved region and decreased data traffic from initial location.

The numbers of mobile stations chosen carefully, so there is double number of nodes at the left (8- stations) while there are (4- station) at the right side to determine many elements like time needed to start and end roaming, WLAN data traffic received in destination traffic stations (A, B) and throughput data rate.

We can conclude from this paper there is around ten seconds every station will be idle to make scan to find the target access point in new location. Another conclusion we can get from this paper is unconnecting between two access points and collecting two destination traffic data at the same location to verify roaming functionality.

9.References

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