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HANDOFF IMPLEMENTATION IN IEEE 802.11 WIRELESS LOCAL AREA NETWORK USING RIVERBED MODELER

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ABSTRACT

Currently existed IEEE 802.11 Wireless Local Area Network (WLAN) can satisfy different needs and requirements of mobile users. WLAN user with infrastructure mode demand's uninterrupted communication while in movement. Therefore mobility and handover management is measured as one of the important research issues in WLAN. In this paper we implement the handoff to evaluate the performance of WLAN. We use Riverbed Modeler 17.5 simulator to study the IEEE 802.11 mobility when mobile nodes roam between the (APs) access points. The result from our simulation helps us to estimate the performance of the wireless local area network.

Keywords: Handoff, Mobility, WLAN, Performance, Riverbed Modeler.

INTRODUCTION

A handoff in WLAN is the process that allows a mobile user (STA) to change of access point (AP). When a mobile user (STA) is roaming and detects there is access point which has better signal strength then it decides to perform a handoff and disconnects from the candidate AP. When mobile user's connectivity changes from one base station to another base station of different networks is known as vertical handoff [7] and the transition of mobile user's from one base station to another base station of same network is called horizontal handoff [7]. During a handoff, the station cannot communicate with any host in the internet, only 802.11 management frames [5] are exchanged with the infrastructure in order to establish a secure association with the next access point.

RELATED WORK

In [11] a survey discusses the issues such as underline network architectures, integrated architectures, mobility management, and quality of service (QoS). Their study focuses on handoff QoS mapping and how seamless voice, multimedia and data handoff becomes possible. Authors of [10] proposed a client based vertical handoff system to provide seamless connectivity in wireless networks. They designed a system with common network interface at a client side and provide transparent service to IP/MIP layers. The work in [12] proposed a novel approach to reducing the re-authentication time. An uthentication server (AS) is used in this approach to periodically assign its authentication authority to the authenticated APs and then APs can authenticate the roaming users on behalf of the AS. The work in [13] proposed a scheme consists of a battery lifetime-based handover policy and cross-layer fast handover scheme, called the SIP-based mobile stream control transmission protocol (SmSCTP). The proposed SmSCTP scheme has been implemented in Linux system and results demonstrate better signaling cost, hand-off delay time, packet loss and delay jitter than SIP and mSCTP protocols. The authors of [14] introduced a new mixed integer linear optimization problem that allows to optimize handovers but takes into account signaling and communication interruption in the handover. The optimized scheme is designed that uses estimates of future station arrivals and mobility patterns.

WLAN PROTOCOL

IEEE 802.11 specifies [2] a set of Wireless LAN standards developed by working group of IEEE LAN/MAN Standard Committee. The Wireless LAN protocol [1] is based on a cellular architecture [4], where each cell is managed by a Base Station (BS) [3], commonly known as Access Point or AP). Such a cell with the BS and the stations (STA) is called a

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Basic Service Set (BSS) and can be connected via a backbone (called Distribution System or DS) to other cells, forming an Extended Service Set (ESS). APs announce their presence using periodic "Beacon Frames" containing synchronization information. If a STA desires to join a cell, it can use passive scanning, where it waits to receive a "Beacon Frame" or active scanning, when it sends "Probe Request" frames and receives a "Probe Response" frame from all available APs. Scanning is followed by the Authentication Process and if that is successful, the Association Process. Only after this phase is complete the STA capable of sending and receiving data frames.

HANDOFF DETECTION

When the signal quality reaches a minimal threshold, the station may take the decision to initiate a handoff in order to connect to other APs offering better quality of signal. This is often referred to as handoff detection. The signal strength and signal to noise ratio are the most used metrics [7]. Signal strength decreases when the station is getting out of the radio range of the current AP, or when an obstacle between the STA and AP is blocking the signal. Signal to noise ratio, on the other hand, generally worsens because of radio interferences.

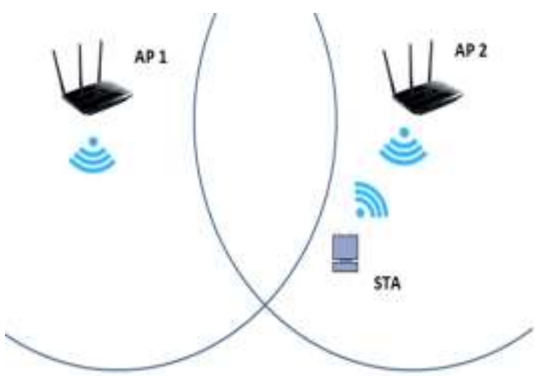

Fig. 1(a) STA (Mobile User) in Range of AP2

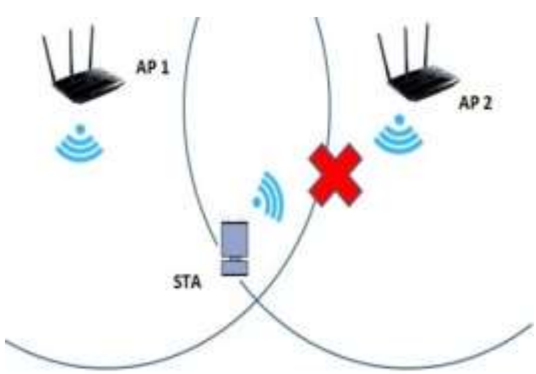

Fig. 1(b) STA(Mobile User) moving out of AP2's range

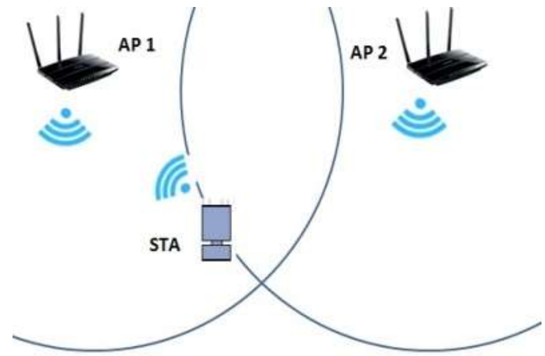

Fig. 1(c) STA (Mobile User) in the range of AP1

Figure 1 shows a network with two access points (AP1, AP2) and a STA (Mobile User). Initially STA is associated with the AP2. When STA starts moving it goes out of the coverage area of AP2. As shown in figure 1(b) STA is disconnected from AP2 because of low signal strength. The figure 1(c) shows the handoff is performed and STA is reaches to the coverage area of AP1 and associates with it.

802.11 HANDOFF PHASES

The Handoff procedure is divided into following phases:

A) Scanning: To perform a handoff, STA finds an AP on which it may switch and this phase is known as scanning. Scanning can be of two types passive and active. In Active scanning a STA simply waits for *beacon* frames issued by the APs. In Active scanning the STA can actively requests beacons by issuing *probe request* frames. A station (STA) can associate with only one AP at a time and therefore in the scanning STA attempts to find APs with higher signal strength.

B) Authentication: After completing the scanning process an AP is selected by the STA using RSS (Received Signal Strength) indication. WLAN STA requires exchanging the Authentication request message for its association to new AP.

C) Association: In this phase the STA associates with the new AP by sending an Association Request and receiving an association ID. The Re-association frame includes the information of new associated AP and new AP will coordinates the forwarding of data waiting for transmission in the buffer of old AP.

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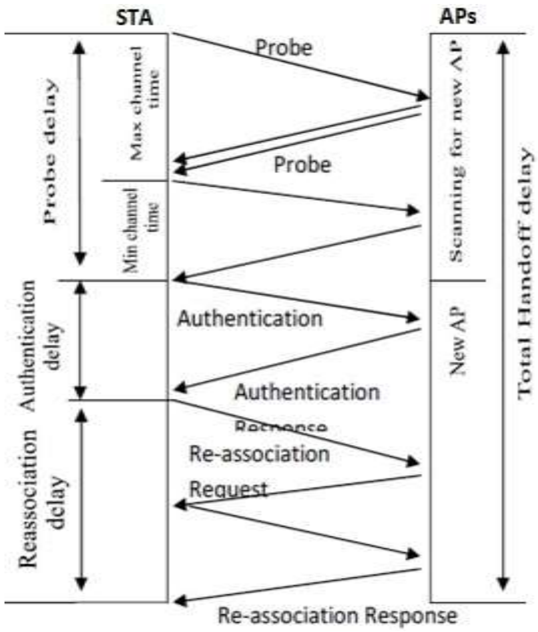

Fig.2 Handoff Procedure in WLAN

HANDOFF IMPLEMENTATION IN WLAN

We used Riverbed Modeler 17.5 [8, 9] simulator for handoff implementation in WLAN. The technologies used to setup the network are wireless_lan and wireless_lan_adv. The Network Scale is used as campus with X and Y span of 1 × 1 kilometres. Wireless LAN Server and Wireless LAN Workstation nodes used as wireless stations and APs respectively. We perform our simulations with 802.11g mode of operation. The goal of this implementation is to achieve Handoff while mobile users (STA) move between the access points.

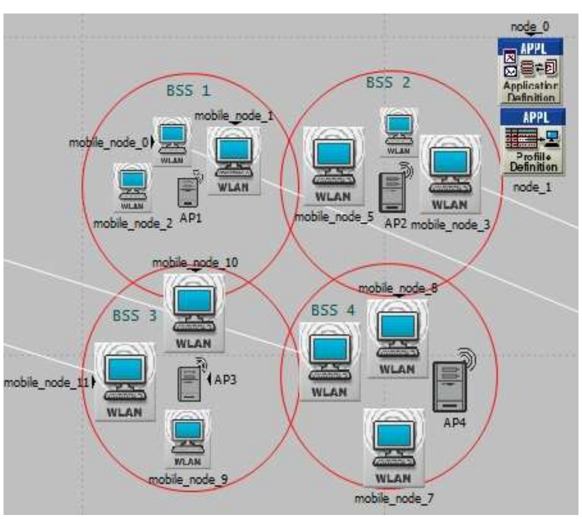

Fig.3 Network Setup for Handoff Implementation

Figure 3 shows the details of the WLAN network for Handoff implementation.

Type: workstation

Attribute	Value
name	mobile_node_0
model	wlan_wkstn
Wireless LAN Parameters	(...)
BSS Identifier	1
Access Point Functionality	Disabled
Physical Characteristics	Extended Rate PHY (802.11g)
Data Rate (bps)	54 Mbps
Channel Settings	Auto Assigned
Transmit Power (W)	0.005
Packet Reception-Power Threshold...	-95
Rts Threshold (bytes)	None
Fragmentation Threshold (bytes)	None
CTS-to-self Option	Enabled
Short Retry Limit	7
Long Retry Limit	4
AP Beacon Interval (secs)	0.02
Max Receive Lifetime (secs)	0.5
Buffer Size (bits)	256000
Roaming Capability	Enabled
Large Packet Processing	Drop

Fig.4 Mobile Node Parameters

Type: server

Attribute	Value
name	AP1
model	wlan_server
Wireless LAN Parameters	(...)
BSS Identifier	1
Access Point Functionality	Enabled
Physical Characteristics	Extended Rate PHY (802.11g)
Data Rate (bps)	54 Mbps
Channel Settings	Auto Assigned
Transmit Power (W)	0.005
Packet Reception-Power Threshold...	-95
Rts Threshold (bytes)	None
Fragmentation Threshold (bytes)	None
CTS-to-self Option	Enabled
Short Retry Limit	7
Long Retry Limit	4
AP Beacon Interval (secs)	0.02
Max Receive Lifetime (secs)	0.5
Buffer Size (bits)	256000
Roaming Capability	Disabled
Large Packet Processing	Drop

Fig. 5 Access Point (AP) Parameters

Figure 4 and 5 displays the Mobile Node and Access Point (APs) system parameters for simulation setup. All mobile nodes in the network defined with a trajectory. Initially BSS identifier for all mobile nodes set according to their location and roaming capability set as enabled. All WLAN server nodes set with a unique BSS identifier and Access Point functionality set as enabled.

SIMULATION RESULTS

The simulation is conducted for the network setup shown in figure 3 using Riverbed Modeler 17.5 [8, 9] simulator. The network used for simulation contains 4 Access Points (APs), 8 Workstation Nodes, 4

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Mobile Stations, an Application Definition and Profile Definition. The simulation time for this project is taken to be 60 minutes. Results of handoff implementation after completing the simulation are given below as.

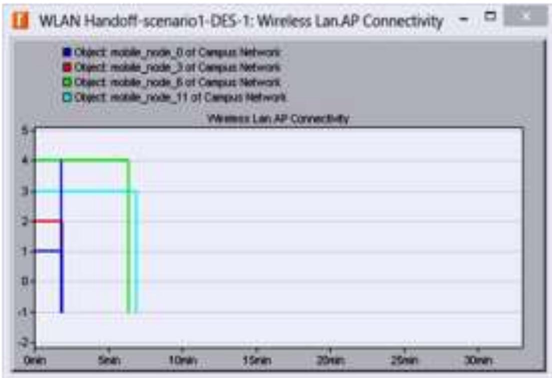

Fig. 6 AP Connectivity of all mobile nodes

Figure 6 plots the AP connectivity of all mobile nodes in the Wireless LAN. When a mobile node roam between the access points (APs) then this indicates whether the mobile node is connected to an AP or not. When the mobile node is disconnected from its present AP a value of '-1' is appears and when it is connected to a new AP then 'BSS ID' of the new AP is recorded. If the roaming capability of the mobile node is not enabled then 'BSS ID' of th
e AP is recorded which is the initially associated with it.

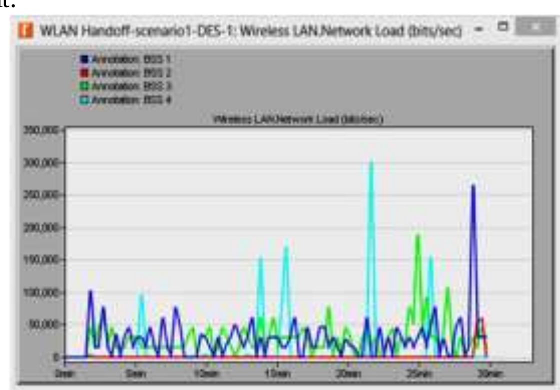

Fig. 7 Network Load on AP1 to AP4 in (bits/sec)

Figure 7 represents the wireless LAN network load in (bits/sec). All BSS have different load but we observe that BSS4 is heavily loaded and BSS2 is having the lesser load among the BSS. Network Load represents the entire data load (in bits/sec) on WLAN transferred from the upper layers. It doesn't include data load which is rejected due to large data packet size in WLAN. The data load which is transmitted in WLAN by APs is counted for the network load.

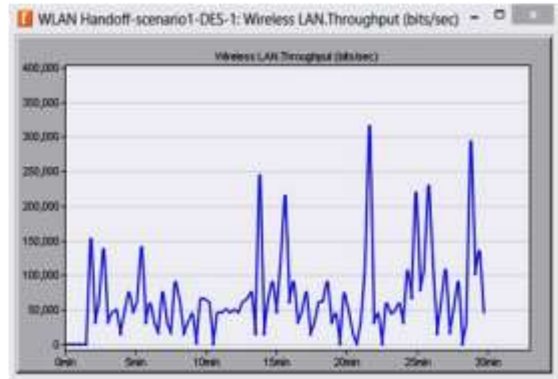

Fig. 8 Network Throughput in (bits/sec)

Figure 8 shows the global throughput of Wireless LAN. It represents total bits transmitted by WLAN nodes to upper layers in WLAN. The result shows the maximum throughput value of network reaches to 320000 (bits/sec).

CONCLUSION

This paper implements the handoff in WLAN. We use the Riverbed Simulator to present the various network performance results with mobile node handovers in WLAN. The AP connectivity result shows the association, disconnection and re-association of all mobile nodes in wireless network. The network performance is measured with two different parameters. These parameters evaluate the network performance as Network load and Throughput of WLAN. In future different parameters can be considered to implement and evaluate the network performance with handoff in WLAN.

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Author Biblography

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