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Congestion Avoidance in Wireless Networks by Analysis of People Mobility Behavior Study

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Abstract: Wireless Local Area Networks (WLAN) are mostly used in various standard organizations and universities in the world. A WLAN links two or more devices using some wireless distribution method and usually provides a connection through an Access Point (AP) to the wider internet. This enables the users to move around within the organization or university campus and still be connected to the WLANs. This is a system that enables wireless interconnection of access points in an IEEE 802.11 network. It allows a wireless network to be expanded using multiple APs. The proposed Wireless Distribution System (WDS) preserves the MAC addresses of client packets across links between various APs. This WDS approach analyses people mobility behavior and provides the information about where the most number of users are using the same APs that leads to congestion in wireless networks. Further more, this WDS also gives best solution for Congestion Avoidance in wireless networks.

Keywords : People Mobility , WLAN, Congestion Avoidance, Wireless network

I. INTRODUCTION

Wireless Local Area Networks are widely used in Universities, Government Organizations etc. This wireless networks are usually based on the IEEE 802.11 standards. WLANs have advantages when compared with wired LANs. A WLAN makes it simple to add or move workstations and to install access points to provide connectivity in areas where it is difficult to lay cable. Temporary or semi permanent buildings that are in range of an access point can be wirelessly connected to a LAN to give these buildings connectivity. Wired network points would be needed for each of the access points. A WLAN has some specific advantages:

A. It is easier to add or move workstations.
B. It is easier to provide connectivity in areas where it is difficult to lay cable.
C. Installation is fast and easy, and it can eliminate the need to pull cable through walls and ceilings.
D. Although the initial investment required for WLAN hardware can be similar to the cost of wired LAN hardware, installation expenses can be significantly lower.
E. When a facility is located on more than one site (such as on two sides of a road), a directional antenna can be used to avoid digging trenches under roads to connect the sites.

Wireless technology is used in the transportation and shipping industry. The automated vehicle location system uses this technology through a combination of satellite and landline systems coupled with the Internet.

In this paper, we have used the data obtained from WLAN so as to study the mobility of the users. This information can be used to know how many users are likely to be at a place and in a specific period of time. This status about the current situation is sent to the users as a message by using the information system thereby reducing congestion of users at a place.

Further this paper is categorized as follows. We discuss about the Related Work and our proposed system approach. We elaborate the Wireless Distribution System, where our university layout and the usage of APs by the users are discussed. People Mobility Tracking shows the implementation part. We use NodeXL tool. which is a template for Excel 2007 and 2010 that lets you enter a network edge list, and see the network graph, in the Excel window. This is followed by our Congestion Avoidance that interprets MAC address to IP addresses and sends the information to the end users about the congestion in an area.

II.RELATED WORKS

Related to our system of people mobility behavior and tracking some of them are of the following. In [2], B. Issac et al. presented a predictive mobility management system which could make mobility on an IEEE 802.11 network more proactive with minimum loss and delay, when compared to existing schemes. Their proposal is focused on WLAN installations within a restricted campus and to predict the mobility path of a mobile node and use that information to lessen the handoff delay.

A wireless indoor tracking system, based purely in software because no additional hardware and costs are required, is described in [9]. It can be used to track and locate both moving and static WLAN-enabled devices inside a building. The system uses complex mathematic algorithms and determines the locations of the mobile devices according to the received signal strength from visible access points. The author categorizes the WLAN-based location determination

algorithms, into two groups: deterministic and probabilistic algorithms. Finally, he concludes the paper making some reflections about the number of APs and their correct localization in order to obtain reliable results, among other things.

The Authors in [8] have presented a user mobility study based on the roaming of the MACs in WLAN of the "Universidad politenica of Valencia". They have studied the buildings with higher mobility in the campus. SNMP agent is activated in all APs. Everytime a MAC address is registered to an AP, it sends a SNMP trap message to a central server which is stored in a database and then analyzed. The data of total no. of registered users in a day and in a month is collected from the central server. This analysis presents the maximum amount of roaming of users between buildings. This study recommends the relocation of bandwidth scenarios to increase the comfort of the end user. According to the user mobility, the system will be giving more bandwidth in the areas where there are more users.

III. WIRELESS DISTRBUTION SYSTEM

A Wireless Distribution System (WDS) is a system that enables the wireless interconnection of access points in an IEEE 802.11 network. It allows a wireless network to be expanded using multiple access points without the need for a wired backbone to link them, as is traditionally required. The notable advantage of WDS over other solutions is that it preserves the MAC addresses of client frames across links between access points.

VIT University is distributed on two campuses. One of them is located in Vellore and contains about 75% of the students and staff of the University. There are around 1200 faculties, 900 Administrative and Technical staffs and around 18500 students among the two campuses. These campuses are equipped with wireless IEEE802.11 b/g network. It has about 300 access points to have full coverage. Vellore Campus has 245 access points and Chennai campus has 55 access points. The distribution of APs in Vellore campus is: 30 APs are in Main Building (MB), 25 APs are in Sir. M. Visweswaraya block (SMV), 50 APs are in Technology Tower (TT), 75 APs are in Silver Jubilee Tower (SJT), 50 APs are in GD Naidu Block (GDN), 10 APs are in Guest House (GH) and 5 APs are in Food Court. These APs are installed to allow the users to freely roam around the campus. For indoor environments, APs coverage area varies between 30 m at 54 Mbps and 137m at 1 Mbps.

Figure.1. The layout of VIT University , Vellore Campus

IV. PEOPLE MOBILITY TRACKING

The mobility tracking involves analysis of registered MACs in a building. This study helps in relocating some schools, staff rooms, labs and cafeteria in order to release over traffic of users in an area. This helps in construction of new university with effective mobility ease. In this section we discuss about the measurements and parameters involved in the analysis.

A. Parameters and Measurements:

All APs are activated with SNMP agent which sends the SNMP trap message to the central server whenever a MAC is registered to it. All APs are grouped based on the location of it. In our university, each APs are designated with the building name followed by the MAC addresses. So, it is easy to group and categorize APs. The database has a table which gives a day and month information along with AP DNS name and MAC address associated with it. With this we can analyze the following

a. MACs registered
b. MACs that shows mobility between buildings.
c. MACs with APs during a day and a month
d. APs where there is more MACs registered

Table 1. MAC addresses with its relevant IP address

Sno	MAC Address	IP Address
1	00-1C-BF-10-E9-67	192.168.145.13
2	00-1C-BF-10-BE-AE	192.168.145.14
3	00-1C-BF-11-38-47	192.168.145.21
4	00-1C-BF-11-2F-31	192.168.145.25
5	00-1C-BF-10-DD-EA	192.168.145.27
6	00-1C-BF-11-52-51	192.168.145.31
7	00-1C-BF-10-B6-8C	192.168.145.36
8	00-1C-BF-11-47-E8	192.168.145.40
9	C0-CB-38-26-C3-94	192.168.145.42
10	00-1C-BF-11-3C-2B	192.168.145.43

The above Table.1 is used to find the corresponding MAC address for all IP address of all mobile computers used within the VIT university campus.

B. IP Address of Wi- Fi Users:

Advanced IP Scanner is a free, fast and easy-to-use network scanner for Windows. In a matter of seconds, this utility finds all the computers on your network and provides easy access to their various resources, whether HTTP, HTTPS, FTP or shared folders. Advanced IP Scanner can wake up and shut down remote groups of Windows machines. Radmin remote access software allows the user to connect to any scanned machine with Radmin Server.

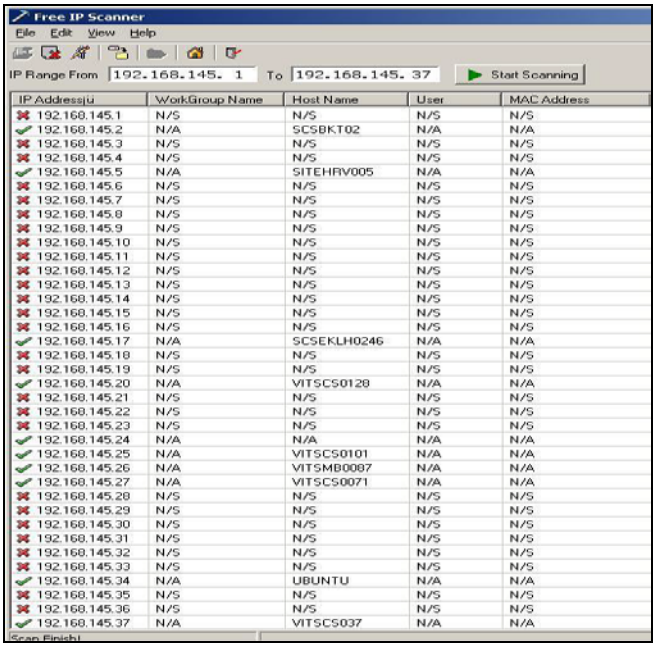

Figure.2. IP address of current users within the University Campus

C. No of Systems Registered:

In each and every building of VIT University campus which are listed above have one Access Point . The users of the system are registered in the corresponding Access Point of the building of the University Campus. The total number of systems registered in building wise of the University Campus is calculated.

Table.2 No of Systems registered

S.No	Building	No. of Systems registered
1	Main Building	3501
2	Sir. M. Visweswaraya block	2562
3	Technology Tower	1457
4	Silver Jubilee Tower	4214
5	G.D Naidu Block	2562
6	Guest House	15
7	Food Court	525
	Total	14836

The above Table.2 shows the number of systems registered in each buildings of VIT university Vellore campus.

V. CONGESTION DETECTION

The online mobility tracking system is based on the number of systems registered in an Access Point. AP sends the SNMP trap message to the central server that controls all APs. The MAC addresses registered in an AP is traced out in the server. At an instant, the number of users registered in all APs in the university is collected and are categorized based on building names. With this data the total number of users registered in all buildings are computed and the building with maximum number of users registered is found using the graph drawn by NodeXL toolkit. NodeXL is a template for Excel 2007 and 2010 that allows the user to enter a network edge list, click a button, and see the network graph, all in the Excel window. NodeXL easily customize the graph's appearance; zoom, scale and pan the graph; dynamically filter vertices and edges; alter the graph's layout; find clusters of related vertices; and calculate graph metrics.

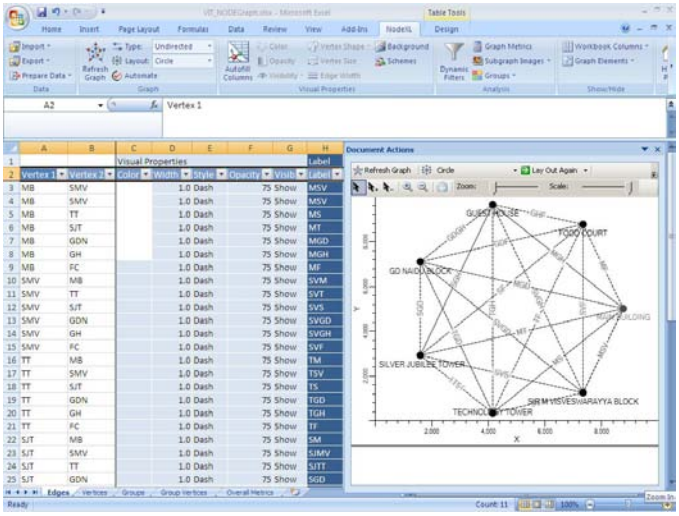

Figure.3. NodeXL graph showing no of systems registered in each building

A. Congestion Avoidance:

From the NodeXL graph the where the maximum number of users are registered is found by analyzing the network graph. This message of building with maximum population is detected as Congestion Place in the University.

This information about the congestion is conveyed to all the users who are currently active in the wireless network or to a particular user from the central server by using NET SEND command. To send a message to a particular user who is connected to the network at that instant, we use IP scanner tool. This tool confirms the systems which is live within the coverage area of APs. Message is sent to a particular system by having either the hostname or IP.

After receiving this alert message about the congestion , the users can use the other Access Points of respective building of the University Campus so that the user can get the better bandwidth and performance.

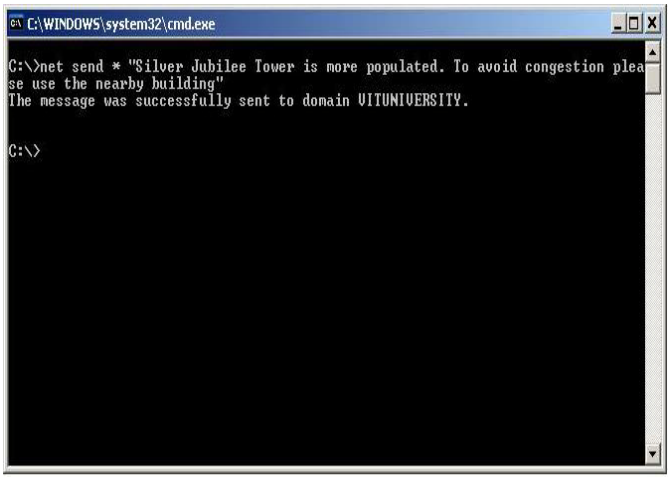

Figure.4. Alert about the Congestion in a Place to the user.

The above Figure.4. shows the alert message about the congestion in a place of VIT University Campus.

VI. CONCLUSION

This people mobility behavior study in the University campus has shown that congestion can be avoided, thereby eliminating the problem of over load in Wireless Network usage. We have studied the roaming behavior of people inside the campus between the buildings. Using the obtained data we have analyzed the behavior of users in the campus. This lets us increase the bandwidth scenarios to increase the comfort of the faculties and students. According to the proposed system the users can be relocated to the networks where there is less bandwidth usage to enjoy the better performance.

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