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Positioning of Wi-Fi Access Points for Optimum Coverage of Campus Wide Network

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ABSTRACT: Many previous studies have examined the placement of Wireless Fidelity (Wi-Fi) Access Points to improve community's understanding of characteristics of wireless networks. Locating and appropriately positioning the Access Points has been important for wide range of purposes and to provide network, with quality speed, wherever required. In this paper, we focus on measuring the signal strength of a particular network selected, in Vishwakarma Institute of Technology (VIT), Pune and identifying the area covered by the current Access Points. Also, taking into consideration the current number of Access Points, their range and the dead zones formed, new positions for these Access Points have been identified.

KEYWORDS: Wi-Fi strength, Acrylic Home, Access Points, Deadzones.

I. INTRODUCTION

In today's 21st century, the basic needs of a human being have been modified. The 4th and the new addition to the existing three basic needs is the Internet, both in public as well as private domain. The one which most widely serves internet in public domain is Wi-Fi Technology.

Wi-Fi is aimed at use within unlicensed spectrum 2.4 GHz [1]. The downside is that this spectrum is also shared by many other users and as a result the system has to be resilient to interference. IEEE 802.15.4 based wireless networks, Bluetooth and many more communication technologies and home appliances like microwave are also using the same frequency band used by the Wi-Fi [2] [3].

This paper mainly focusses on the measurement of the strength of "VIT_CAMPUS" which is a free Wi-Fi network provided in VIT, Pune for educational purpose. Also, the existing access points are studied. Additional access points and their position are also designed.

II. WI-FI CHANNELS

ISM Bands: There are a number of unlicensed spectrum bands in a variety of areas of the radio spectrum. These bands are called as Industrial, Scientific and Medical (ISM), which includes everything from microwave ovens to radio communications.

The main bands used for carrying Wi-Fi are those in the table below:

Table .1 – ISM Wi-Fi Bands [4]

LOWER FREQUENCY MHZ	UPPER FREQUENCY MHZ	COMMENTS
2400	2500	Often referred to as the 2.4 GHz band.
5725	5875	This 5 GHz band or 5.8 GHz band.



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There are several different 802.11 variants in use. Different 802.11 variants use different bands. A summary of the bands used by the 802.11 systems is given below

Table .2- 802.11 Systems [4]

IEEE I802.11 VARIANT	FREQUENCY BANDS USED
802.11a	5GHz
802.11b	2.4GHz
802.11g	2.4GHz
802.11n	2.4 & 5 GHz
802.11ac	Below 6GHz
802.11ad	Up to 60 GHz
802.11af	TV white space (below 1 GHz)
802.11ah	700 MHz, 860MHz, 902 MHz, etc. ISM bands dependent upon country and allocations.

Network selected for measurement:

The network selected for measurement is of Vishwakarma Institute of Technology,Pune.

Table .3- Network Information

SSID	VIT_CAMPUS
MAC Address	00:1B:2A:23:BA:F0
Channel No.	4
802.11 Variant	b, g
Vendor	Cisco Systems. Inc

III. METHODOLOGY

Software used for measurement: A large number of paid as well as free open source softwares and applications are available to measure various parameters of Wi-Fi signal. We have chosen Wi-Fi Acrylic Home: Version: - v3.1.6117.24454. The home version of Acrylic Wi-Fi is free for personal use. It is designed to run on Windows Vista, Windows 7, Windows 8, 8.1, 10. The app is able to identify local wireless access points and devices, and will display a table which lists the details including, SSID, MAC Address, Vendor, type, RSSI, channel, 802.11 (a/ b/ g/ n/ ac), security details (WEP/ WPA/ WPA2/ WPS), and data on when these were seen [5].

Key Features include:

- Access points: Wi-Fi networks information and connected users.
- Channels: Wi-Fi channel scanner and Wi-Fi networks through channels in 2.4 GHz and 5 GHz.
- Security: Network authentication and security details for WEP, WPA, WPA2 and Enterprise (802.1X) Wi-Fi networks.
- Signal level: Signal quality charts for Wi-Fi channels and detected devices.
- Inventory: Naming known Wi-Fi devices.

Data Collection: The strength of selected network was recorded at various places in Vishwakarma Institute of Technology, Pune. Each floor of all the four buildings, common areas such as Main canteen, Boat Club, Ground, Lawn, Auditorium, Library, Reading hall were covered during sampling the data.



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The strength for various floor are listed in the tables below:

Table .4– Wi-Fi strength - Ground Floor

Building	Place	Value(in dBm)	Strength
1	Internet lab	-79	Good
1	TPO	-79	Good
1	Student Section	-93	Weak
1	1809	-87	Moderate
4	4002	-90	Moderate
4	4004	-92	Weak
4	4009	XX	Dead-zone
-	Ground	-84	Moderate
-	Lawn	-72	Good
-	Library	-85	Moderate
-	Canteen	-81	Moderate
-	Nescafe	-90	Moderate
-	NPB	-85	Moderate
-	Boat club	-66	Better
-	Fruit Centre	-82	Moderate

Table .5 – Wi-Fi strength -First Floor

Building	Place	Value(in dBm)	Strength
1	FY notice board	-85	Moderate
1	1116	-87	Moderate
1	1126	-86	Moderate
2	2104	-82	Moderate
2	2108	XX	Dead zone
3	3103	-94	Weak
3	3106	-87	Moderate
4	4104	-98	Weak
4	4109	XX	Dead zone
4	4111	XX	Dead zone



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Table .6– Wi-Fi strength - Second Floor

Building	Place	Value(in dBm)	Strength
1	1201	-92	Weak
1	1217	-88	Moderate
1	1224	-71	Good
1	lunch space	-90	Moderate
2	2204	-93	Weak
2		XX	Dead zone
3	Drawing lab	-93	Weak
3	CAD lab	-85	Moderate
4	4203	-94	Weak
4	4206	XX	Dead zone
4	4209	XX	Dead zone

Table .7– Wi-Fi strength - Third Floor

Building	Place	Value(in dBm)	Strength
1	1301	-89	Moderate
1	1324	-88	Moderate
1	1326	XX	Dead zone
1	1320	-94	Weak
2	2304	-94	Weak
2		XX	Dead zone
3	3305	-87	Moderate
3	Heat transfer lab	-91	Weak
4	4304	-94	Weak
4	4306	-92	Weak
4	4309	XX	Dead zone

Table .8 – Wi-Fi strength - Fourth Floor

Building	Place	Value(in dBm)	Strength
1	1409	-88	Moderate
1	terrace	XX	Dead zone
1	1413	XX	Dead zone

Data Analysis: According to the samples collected, the data was plotted on the campus map. The final floor-wise plot showed the dead-zones at various locations. Also, the WiFi strength recorded were divided into different levels as shown in table below:

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Table .9 – Wi-Fi Strength parameterized

Signal Value (in dBm)	Strength
-60 to -70	Better
-70 to -80	Good
-80 to -90	Moderate
-90 to -100	Weak
XX	Dead zone

There are five access points of Cisco Systems, model number 1310 installed in the campus. The locations are:

1. Information Access Centre
2. Boat Club
3. Reading Hall
4. Auditorium
5. Design Laboratory

The following figure shows the location of Access Points on the campus map.

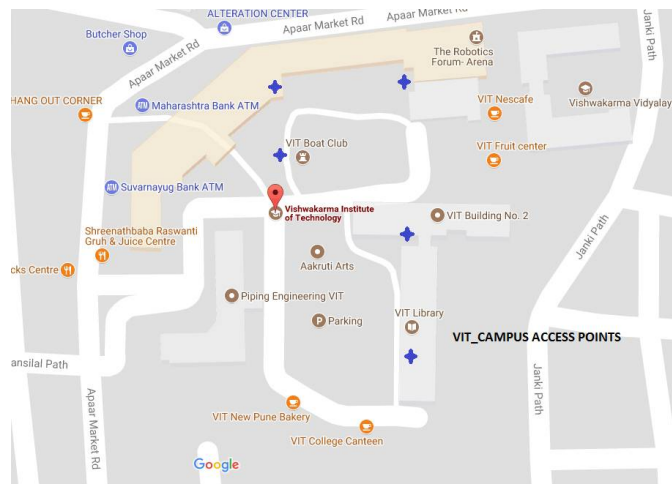


Figure I - VIT_CAMPUS Access Points locations

These access points covered a considerable amount of area in campus. But there are many dead-zones where there is no access to the network. This can be rectified by adding some more access points. The new added access points and the existing access points can be oriented properly so as to provide internet access with a better strength throughout the campus. The same was studied and analyzed with the help of maps plotted and we arrived at conclusions.

IV. CONCLUSION

- The plotting of maps helped us identify the dead zones, located mostly in the 2nd, 3rd and 4th building.
- So as to eliminate these dead zones and ensure that the complete campus receives a better strength of the signal, two Access Points should be installed on alternate floors in the 2nd, 3rd and 4th building, in the campus.
- Two Access Points, one near the Student Section and the other, on the farther end of the 1st building, should be installed.



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