Wi-Fi Network Analysis of University Campus

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Summary
This era is representing the maximum changes in technological aspect, where assortment of things are implanted with the electronic gadgets (such as mobile smart phones, Siri AI speaker, Chromecast, IPTV cameras, smart fans, laptops, smart watches and life monitoring devices etc.). The moving sensors and embedded software (such as control system of air traffic, infusion pump for drug, monitoring & attendance system for students, employees and faculty members etc.) these all frameworks associated through the internet for gathering, monitoring and exchanging the required and most important data. A simple minor mistake or lagging or security breaches in the internet connection can cause great number of loss of money, personal data and confidential information. Securing the network is as much important as securing personal information in the organizations (such as a university campus where thousands of user are connected to the same network). The security of such type of network is very important and is of optimum concerned. The popularity of wireless networks is further enhanced by its ability to communicate using different types of multi- protocol text, audio, video and streaming of global media. Hence, it is an imperative need to secure wireless network, not only to protect personal and business information, but also in light of the recent wireless network security breaches by unauthorized individuals. The aim of this work is to analyze the Wi-Fi network of university campus and evaluate the report which will contain the hardware and software details of all network devices and users. Furthermore, the extensive survey was conducted about users' satisfaction and expectation from Wi-Fi network. This work will improve the efficiency of the Wi-Fi network of university in effective and efficient manner.

Key words:
Wi-Fi Network Analysis, User Feedback, Network Management,

1. Introduction

Internet or the Web has been planned to support the huge number of clients/users because these days, the interface of devices (such as mobile, desktop and sensing devices etc.) through the internet have exceeded over 31 billion devices in the year of 2020. These devices have different versatile and work area (such as online banking, e-commerce and online shopping etc.). Gadgets with an assortment of uses running from the simple basic Web perusing to content conveyance and video conferencing. As more people are dependent on networks and information technology in all aspects of society, the Internet has become an integral part of our life. Internet is decreasing the distance between the virtual world and the real world which is effecting the way of study, work and live [1]. Some social media website like Facebook and twitter are playing very important role now a days, in the list of most popular resources for spreading information social media is ranked forth [2]. Network security has become very important due to rapid increase in network-based services and availability of personal information on networks [3].
These huge number of connections of the internet give birth to the number of difficulties (such as congestion inside the network, dis-connectivity, signal range problem and inadequate support of internet device etc.) and increase the chances of attack on the network [4]. There is a need of network analysis that will overcome these problems efficiently. Because during the process of network analysis all the collective measures done to analysis, study and gather data are done according to the policy requirement of the organization or University [5][6].

2. Literature Review

People's dependency on internet has made Wi-Fi networks an essential part of each organization. Wi-Fi is considered as a utility in all aspects of society now. The Internet has become an integral part of our life. It's changing the study and working environment. Way of living is changing with the enhancement of the technology [1]. Need of Wi-Fi networks is also increased due to the excess use of social networking sites or applications. Social media is playing an important role in our society, it is one of the major resources of spreading information now a days [2]. In an organization such as University campus where thousands of users are connected to the same network, network analysis is very important [3]. Because network health, vulnerabilities, problems and deficiencies can be detected by analyzing. Rapid increase in network-based services and the availability of personal information on networks is one of the important reasons for network analysis [4]. Effective

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and efficient use of network is very important for an organization i.e. in a university the prime objective of Wi-Fi network is to ease the users' essential needs regarding research and education [5]. In order to improve a network we have to understand it first, and network analysis is the first step to understand the pros and cons of any network [6]. ICT service of European University Institute launched a survey in order to know the users satisfaction and problems regarding internet services provided by the university [7]. Such annual survey should be conducted to show the progress in advancing end-to-end network performance. The annual survey could be used to benchmark the progress in upgrading all components of the network and it could be a valuable tool for institutions [8]. IT services of the University of Dublin launched satisfaction survey in order to understand the users' perspective regarding IT services provided by the university [9]. A good Wi-Fi network play an important role in such organizations where user's satisfaction is taken seriously [10]. Because people are use to of wireless technology and they prefer it over wired internet [11]. So, providing a high quality Wi-Fi network in a university for research and educational needs is very essential [12]. But the security of such network and privacy of users' personal information available on network should not have any vulnerability [13]. Network analysis is considered as of the important aspects of security management [14]. Educational institute should provide a high-speed Wi-Fi network so students can fulfill their requirement of video based lessons and research [15].

3. Contribution

This research paper is based on the network analysis of Mehran University of Engineering and Technology Jamshoro. Following are covered in this analysis.

- Information about Wi-Fi network devices.
  - Total Number of different Wi-Fi network devices.
  - Classification of Wi-Fi network devices.
- Wi-Fi network analysis report.
- Users' satisfaction survey.
- Users' satisfaction survey results.
- Comparison of users' feedback with technical findings in order to understand the issues in Wi-Fi network.
- Suggestions for overcome those issues.

4. Methodology

The research is divided into two parts. In first part we gathered all the information regarding Wi-Fi network which includes number of access points, number of switches, classification of these devices, Wi-Fi coverage area, bandwidth and all other technical data with the help of different software and apps while in other part we did a users' satisfaction survey to understand the users' issues regarding Wi-Fi network and then compared that feedback

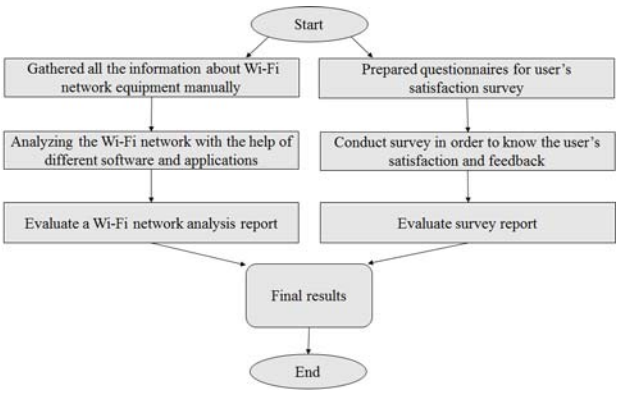

Figure 1: Flow chart of methodology

With the collected technical data in order to understand the real issue and then purposed the solution for that issue.

5. Results

Work started by analyzing the devices which are used in the network. There are total 500 indoor access points in the Wi-Fi network while 11 outdoor Wi-Fi access points these are Huawei AP6050 and AP6150 respectively. These 511 access points are connected to the 84 Huawei switches.

5.1 Huawei Access Points

This model of Huawei access point are the most recent age innovation driving remote passageways (AP). In consistence with the 802.11ac Wave 2 guidelines. They give secure gigabit remote access and supports simultaneous information handling for additional clients. The detailed specification and performance detail (like software specification and maintenance features etc.) provided at the official website of Huawei.

5.2 Surveying the University

All of above described access points are connected to and control by the wireless access controller so the network is not vulnerable to external Wi-Fi devices.
In the survey, different questions were asked to the Wi-Fi users in the university in order to understand their point of

view regarding Wi-Fi network. There are four types of regular Wi-Fi network users in the university, which are students, faculty members, officers and staff members. Majority of the internet users are student because students are the main stakeholders in any institute. So, the first question was asked about their classification. Most of responses were from student side as shown in Fig.2.

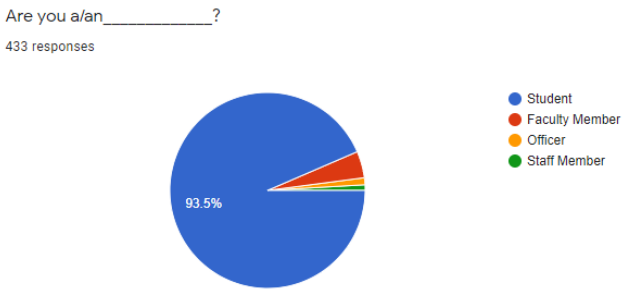

Figure 2: Classification of Wi-Fi users

Frequency of using a network is play important role when you give feedback regarding the network. A regular user can explain real issues and difficulties of the network more efficiently than an occasional user. Most of the users which surveyed were the regular users of the Wi-Fi network as shown in Fig.3.

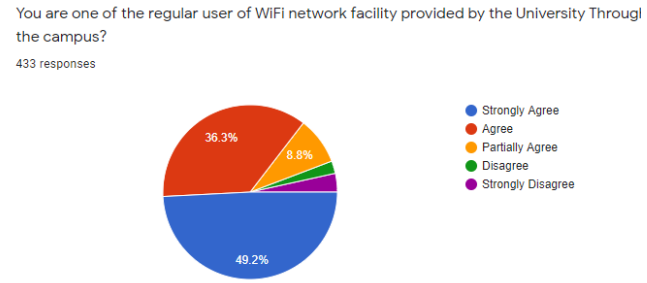

Figure 3: Regularity of Wi-Fi users

University is providing Wi-Fi coverage in all the departments throughout the campus. Users are receiving a good Wi-Fi signal strength in offices, laboratories, libraries, corridor and in some selected outdoor areas. Most of the users preferred to use Wi-Fi network over 3G/4G or any other source of Internet which make the Wi-Fi an essential need in university premises as shown in Fig.4.

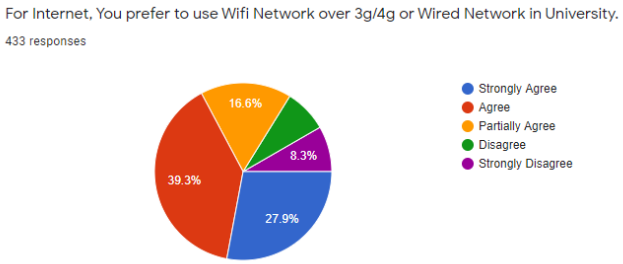

Figure 4: Preferable source of internet in university

When users were asked about difficulties in using Wi-Fi network the majority of users respond that they are feeling difficulties in using Wi-Fi network. Because majority of users were disagreed with the statement that they are not facing difficulties in using Wi-Fi network in university as shown in Fig.5.

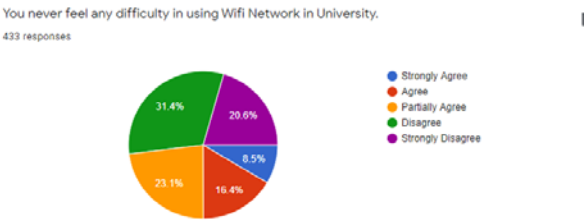

Figure 5: Difficulties in using Wi-Fi network

Most of users have complained about slow browsing issue which is a valid complain as shown in Fig.6. During the peak hours from 10:00 am to 2:00 pm browsing speed was observed very slow.

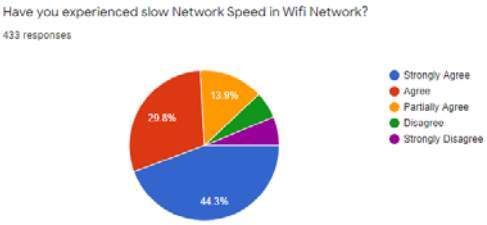

Figure 6: Slow browsing speed issue

Most of the users complained about the disconnecting issue as shown in Fig.7. There are many reasons of disconnecting issue. The main reason of this issue is communication gape. End user does not get the first-hand knowledge of any changing in Wi-Fi network which cause the disconnecting issue.

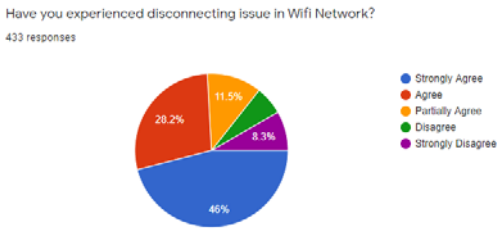

Figure 7: Wi-Fi network disconnecting issue

In order to connect to the Wi-Fi network one should have his/her credentials, these are actually VPN accounts which are generated by the Information and Communicaiton Processing Center of the university. Each student, faculty member and employee should have his own VPN account in order to connect the Wi-Fi network. These VPN accounts are verified by the active directory at the time of connecting. But it seems there are a good number of users who don't have their own VPN accounts as shown in Fig.8.

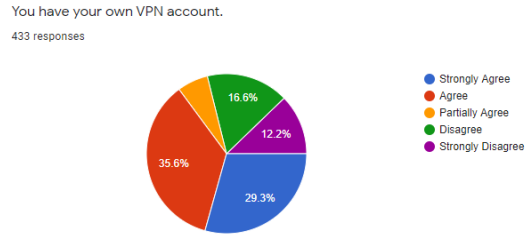

Figure 8: Wi-Fi users' VPN accounts

That means those users are connected through someone else's VPN account as shown in Fig.9. This is a reason of slow browsing. Each users account have a maximum cap of 2 Mbps. If many devices are connected through a single VPN account so the total bandwidth will split among those devices and result will be slow internet speed.

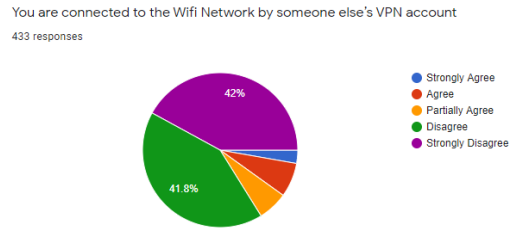

Figure 9: Unauthorised VPN accounts

Many users didn't know that logs are generated against their VPN Account as shown in Fig.10. Means if a user is connected through someone else VPN and misusing the Wi-Fi network in any sense the logs will indicate the VPN owner for that misusing.

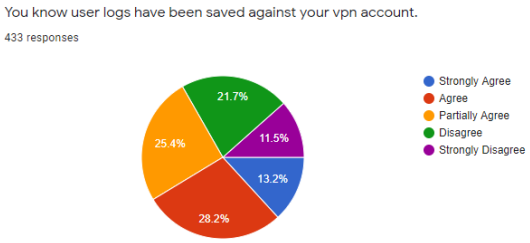

Figure 10: Wi-Fi users' logs

When users were asked the purpose of using Wi-Fi network the majority of users agreed that most of the time their purpose of using Wi-Fi network is social media or entertainment as shown in Fig.11. Most of them are connected to Wi-Fi for whole time they present in university.

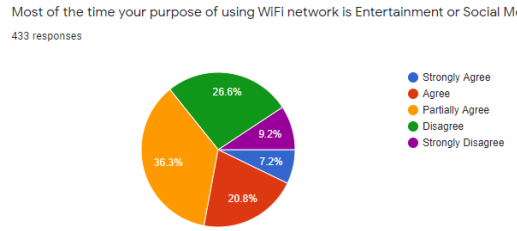

Figure 11: Purpose of using Wi-Fi in university

512 Mbps are allocated for Wi-Fi network. As it observed by the e-sight Network Management System at the peak hours from 10:00 am to 2:00 pm users reached up to 2599 as shown in Fig.12. This is the main reason of slow browsing. University has too many users and a limited bandwidth.

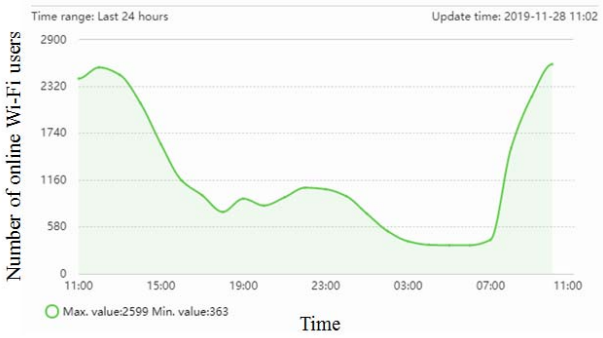

Figure 12: Graph showing online users of Wi-Fi network with respect to time

In University hours 8:00 am to 3:00 pm almost full bandwidth which is allocated for Wi-Fi network is consumed by the user as shown in Fig.13.

Figure 13: Graph showing bandwidth consumption of Wi-Fi network with respect to time

Now look at the Fig.12 and Fig.14 in the peak hours (10:00 am to 2:00 pm) the users reached up to 2000+, this is the exact time when users face slow browsing.
That means users are consuming full bandwidth throughout university hours (8:00 am to 3:00 pm) but in peak hours when users reached up to 2000+ they face slow browsing issue due to equally shared bandwidth policy.

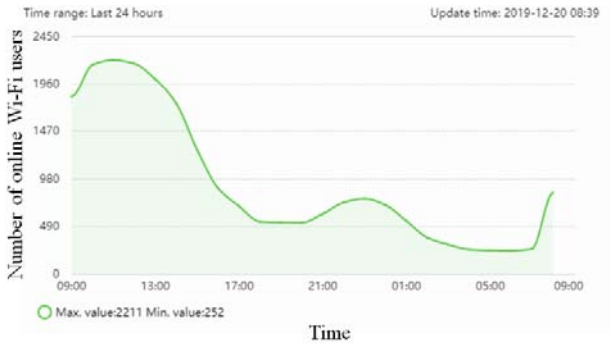

Figure 14: Graph showing online users of Wi-Fi network with respect to time

6. Conclusion

There should be a proper information system by the university which provide the first-hand knowledge to the end users of any changes in Wi-Fi network. Because most of the dis-connectivity issues are due to lack of knowledge regarding changes in Wi-Fi network. University can get rid of slow browsing issue by increasing the bandwidth but it will be a costly solution because bandwidth which is used in Wi-Fi network is purchased from Pakistan Education and Research Network. That bandwidth is costly and exclusive for research and education purpose. But this issue can be resolved by implementing some restrictions and blocking the bandwidth hungry applications and social websites. By doing that university can save the expensive bandwidth and can utilize it efficiently for its real purpose, education and research.

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