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A Survey of IEEE 802.11 wireless standard for WI-FI

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Abstract - *Since the base version of 802.11 released in 1997, wireless local area network (WLAN) has been developing rapidly, and it has gone through many versions and amendments. The 802.11 protocol is now very sophisticated through 23 years of modification. Therefore, it is very hard to understand all improvements, which confuses researchers sometimes, making it not easy to discover the trend of development and adaptation of standard worldwide. This paper tries to summarize utilization of standard by individuals in statistical format then will give idea to researchers that which age group prefers standard most. It would also assist companies to find field of interest.*

Keywords: **Wireless Standard for Wi-Fi, 802.11, Statistical, Indian Population Analysis.**

1.INTRODUCTION

Beginning from 1997, IEEE 802.11 protocol (or protocol family after the release of IEEE 802.11a/b in 1999) is dedicated for a better quality of wireless local area network (WLAN) through establishment and amendment of WLAN standards on media access control (MAC) and physical layer (PHY) specifications. The base version, 802.11, was released in 1997, and then many amendments were released. Today this process of update has not finished yet. The newest standard, 802.11ac, is the newest and fastest standard.

Through 23 years of modification, the 802.11 is now extremely reliable and as it uses 5GHz frequency band which is less crowded and hence has relatively smaller interference problem. In these report we will try to analyze adaptation of this standard by Indian people in day to day life and explore about different companies manufacturing wireless devices based on 802.11 standards. This paper will also help people as well as Companies to predict future of wireless standard for Wi-Fi.

The rest of the paper is organized as follows. In section 2, we described the basics of IEEE 802.11 wireless standard as well as core technology. In section 3 to 5, we represented and analyzed the responses from individuals and predicted the future for this standard.

2.IEEE 802.11 Technology:

The base version, or so-called IEEE 802.11-1997, as this paper mentioned above, was released in 1997. At the very beginning of 802.11, this protocol was developed for rapid deployment of a wireless portable network. That is to say, the first priority is mobility rather than network speed. Though this version was no longer being used, the fundamentals were well defined in it, therefore it is interesting to look into it.

2.1. MAC Architecture and Key Technologies:

In Medium Access Control (MAC) sublayer, there were 2 functions included: the distributed coordination function (DCF) and the point coordination function (PCF).

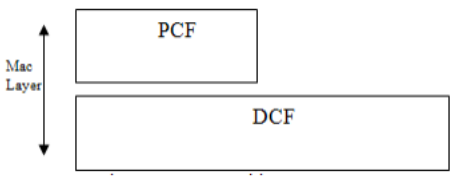


Figure 1 MAC architecture

The PCF is required for contention free services, while the DCF is used for contention services and basis for PCF. The architecture was well defined and it is still being used in latest version (with updates, of course). Figure 1 shows the original architecture of MAC sublayer.

2.1.1. Distributed Coordination Function:

DCF, known as carrier sense multiple access with collision avoidance (CSMA/CA), plays an essential role in IEEE 802.11 family. It allows for automatic sharing of public resources among all stations (STAs). In most cases, the channels STAs working on is busy and thus contention is somehow inevitable. In this situation, when an STA desires to initial a frame exchange, it shall follow a series of basic operations. The STA shall listen to the channel and wait until it determines that the medium would be idle for longer than a distributed inter-frame spacing (DIFS) period. Then, the random backoff time shall be applied given the equation:

Backoff Time = Random () × aSlotTime

Here, Random () generates a Pseudorandom integer which satisfy a uniform distribution over the interval [0, CW], where CW is related to the count of retries, and aSlotTime an attribute dependent on medium. The whole backoff procedure is briefly introduced in 2.1.2.

2.1.2. Backoff procedure:

A backoff procedure shall be invoked if either the physical or virtual carrier sense mechanism determine the channels are busy, or transmitting STA indicates a failed transmission. Figure 2 shows the whole backoff procedure.

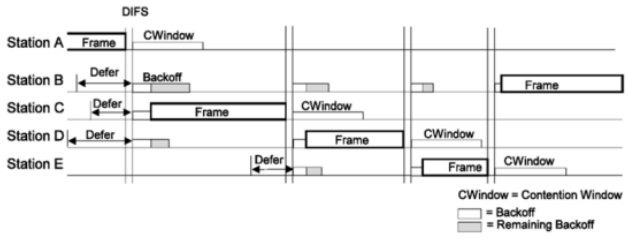


Figure 2 Backoff Procedure [1]

The effect of backoff procedure is that STA with least Random () would win the channel if it is being contended by multiple STAs. The backoff procedure is very basic but effective, and it continues to work in later versions with very little updates.

2.2. PHY Specifications and Key Technologies:

In original version of 802.11, the protocol utilizes the microwave ISM band at 2.4 GHz with 3 different physical layer specifications: frequency hopping (FH PHY), direct sequence spread spectrum (DSSS PHY) and infrared light (IR PHY). IR PHY, though with multiple unique advantages, was not widely used due to security problems and relatively short range, but remaining all are in use with improvements over time.

2.2.1. Physical Layer Overview:

PHY layer is divided into 2 sub layers: The Physical Layer Convergence Procedure (PLCP) sub layer and the Physical Medium Dependent (PMD) sub layer. PLCP is the sub layer between MAC and actual transmission, i.e., PMD layer, which receives data from MAC and adds its header, then pass it to PMD, while PMD sub layer takes responsibility for transmitting. 802.11 uses 2.4GHz – 5GHz ISM band, requiring no licensing as long as the transmitting power and radiation satisfy regulations. However, because of it, all STAs must work under possible noise and contentions

2.2.2. FH Transmission:

FH PHY implements rapid changes on the transmission frequency in a predetermined pseudorandom pattern. Available frequency band is divided into a series of frequency slot with maximum width of 1 MHz, and the time is divided likewise. When transmitting, transmitter will use the pattern to decide the frequency slot for transmission for every time slot. Only if the transmitter and the receiver are using the same channel can the transmission succeed. There may exist multiple transmitters and receivers, and therefore it is not enough if only one patter exists. There are over 20 hop sets, in different region which may differ but are orthogonal, i.e., these sequences would not overlap. When a STA is joining any FY network, it has to synchronize with the network, the specifications for which are: region, sequence number and hop index.

2.2.3. Direct Sequence Spread Spectrum Transmission:

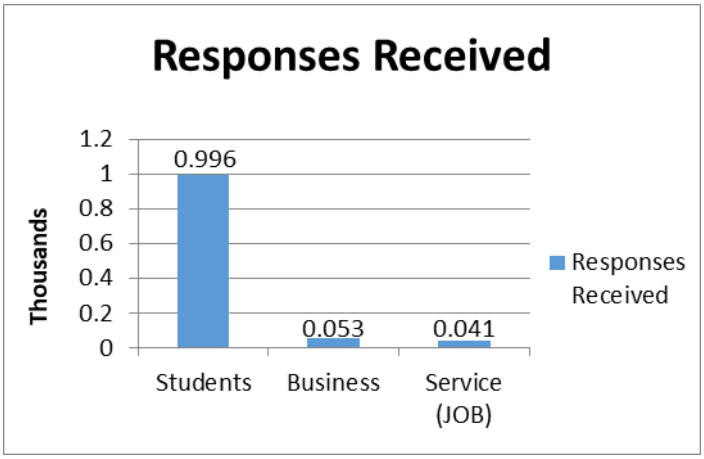
In initial 802.11 specifications, a physical layer based on low-speed, direct-sequence spectrum was introduced. Compared with FH PHY, DSSS PHY costs more power, but this high cost comes with a benefit of much higher data rates. Direct-sequence transmission is a spread-spectrum technique to transmit a signal over a much wider frequency band. The basic approach is to spread the signal by changing the carrier across a wide band, while receiver shall perform a correlation operation to look for the changes. When transmitting data, direct-sequence-modulated works by applying a chipping sequence to the data stream. Direct-sequence-modulated signals could deal better with interference than frequency Advances in Engineering Research, volume 141 571 hopping-modulated signals because this correlation process enables DS systems to work around narrowband interference more effectively. DSSS uses differential phase shift keying (DPSK) as the basis. It encodes data in phase changes in the transmitted signal. Similarly, the simplest DPSK is differential binary phase shift keying (DBPSK), encoding only 0 and 1: reference wave to be 0 while wave with a phase shift of π to be 1. Advanced transmitters and receivers could encode multiple bits per symbol by implementing DQPSK, which encodes 2 bits in 1 symbol.

3. Method:

Data collection is the key part of any survey, it's important to know the individual's thinking for technology and opinions for adaptation of technology. We have conducted small level survey by creating Google forms in two different languages (ENGLISH and HINDI) and circulating to technical as well as non-technical field person via mails, social media. Survey also has been conducted by on paper personal reviews as well as poll creations on social media. In total 7 questions were developed and that were used for survey.

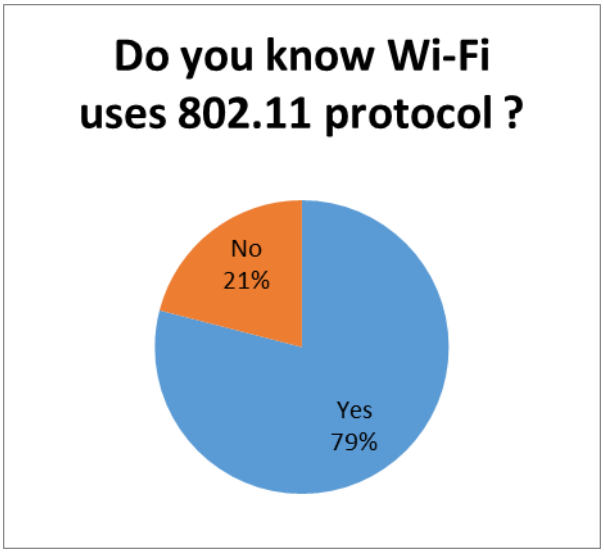
4. Analysis:

In total more than thousands acknowledgement has received, in which we have classified into 3 prime categories 1: Students 2: Business Man 3: Services. Maximum response received from students. Below diagram is a graphical representation of responses received, in which maximum numbers of responders were students from different departments and colleges which is around 1K. Businesses as well as service groups were also included for survey and in total we have received 53 comeback from Business and 41 from services group.



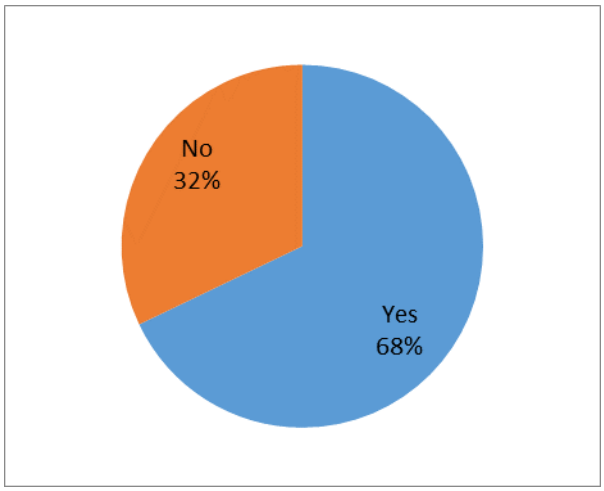
In total we have stated 7 questions in surveys as well as poll. Next part of analysis is from section 4.1 to 4.7 in which question are represented in graphical format.

4.1 Do you know Wi-Fi uses 802.11 protocol?



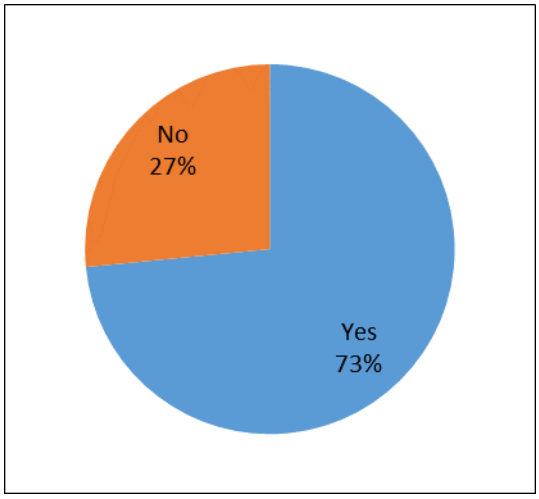
After all the responses, we have analyzed, that 79% are aware about 802.11 protocol , its applications as well as pros and cons, but remaining 21% doesn't have any awareness about this protocol. It states that 21% belongs to non-technical field or they are unrevealed to this technology. Estimating with Indian population, currently India have 1391.99 million populations, now considering our graph, total 79% are aware of this technology in which approximately 1100 responded, as this survey conducted at low level. Considering, all over India same groups will be available so we can esteem that **78% of Indian Population** are familiar with IEEE 802.11 protocol use for Wi-Fi.

4.2 Do you know; we are able to print wireless from your mobile or laptop because of IEEE 802.11 protocol.



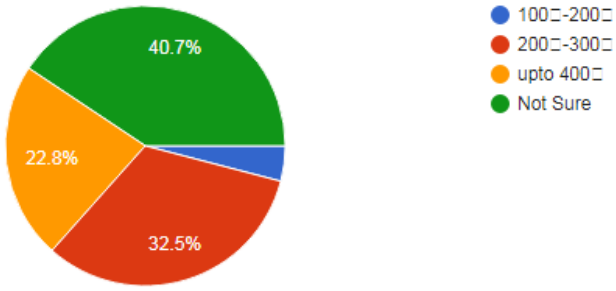
More than half of responders are aware of wireless access over the network. 68% are having idea and remaining 32% are unaware. Comparing with **Indian population, 67.97%** populations may be familiar with wireless access over the network. Remaining 32.03% population can be considered as uneducated or under age.

4.3 Have you encountered 802.11 n Wireless LAN device in your everyday life?



This question also received 73% positive result i.e. individuals are using 802.11n Wireless LAN device in day-to-day life or sensible of device. Weighing up with **Indian population, around 73.46%** are conscious about the device and remaining 26.54% of community is unenlightened with device.

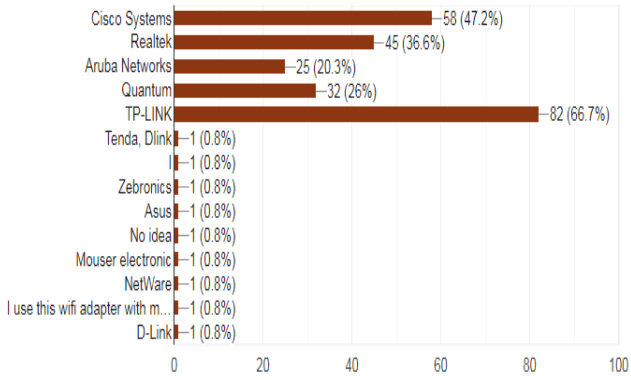
4.4 What is the price of 802.11 n Wireless LAN device in market?



40.7% of them are not sure about the pricing factor, 22.8% of individuals except pricing up to 400 rupee and 32.5% are sure that they will get device in between 200-300 rupee and 4.1% responded pricing in between 100-200 rupee. Pricing factor depends on manufacture that how they lay out products quality in market, poor material will have fewer prices and more demand were as standard will have high pricing and less demand. If comparing with Indian market, people will probably

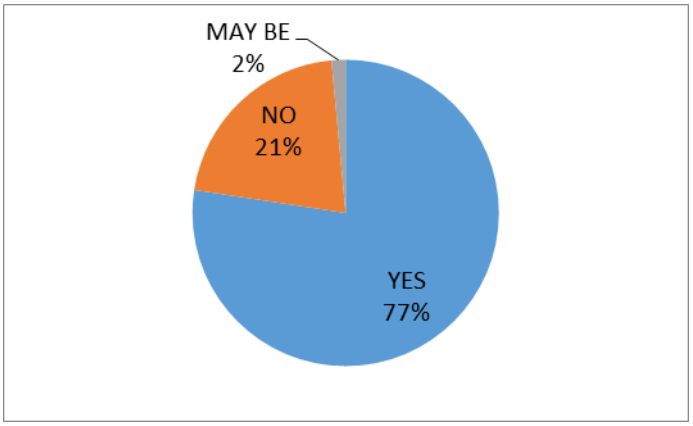
select, average pricing device which will be between 200-400 rupees.

4.5 Are you aware of any companies that manufacture 802.11 n Wireless LAN devices?



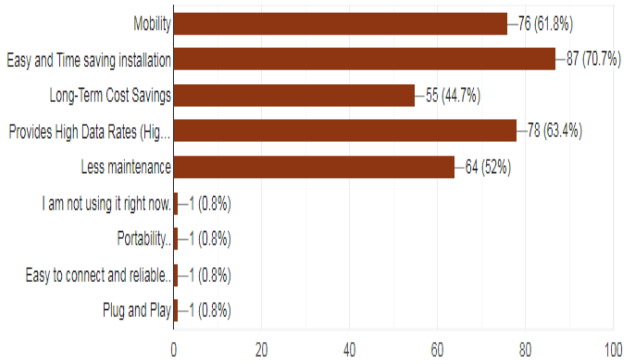
Above diagram stated that, in India majorly societies' are aware of TP-Link Company, it provides the best 802.11n Wireless LAN devices and have satisfactory market reach. Second most known companies in India are CISCO Systems and Realtek with 47.2% and 36.6% of acceptance by communities.

4.6 Do you think that 802.11 protocol (Wi-Fi) will become need of hour?



Here it's very important to know, both for manufactures as well as coming generations, whether Wi-Fi is going to be a routine for every individuals or not. According to survey 77% opinion is YES, it is doing to be need of hour, 21% belief that it is not going to be hours need and 2% are not sure. Estimating with Indian population, **77.46%** may have opinion that this technology is future, **21.13%** viewpoint in no and **2%** school of thought is probably there are 50-50 chances for growth.

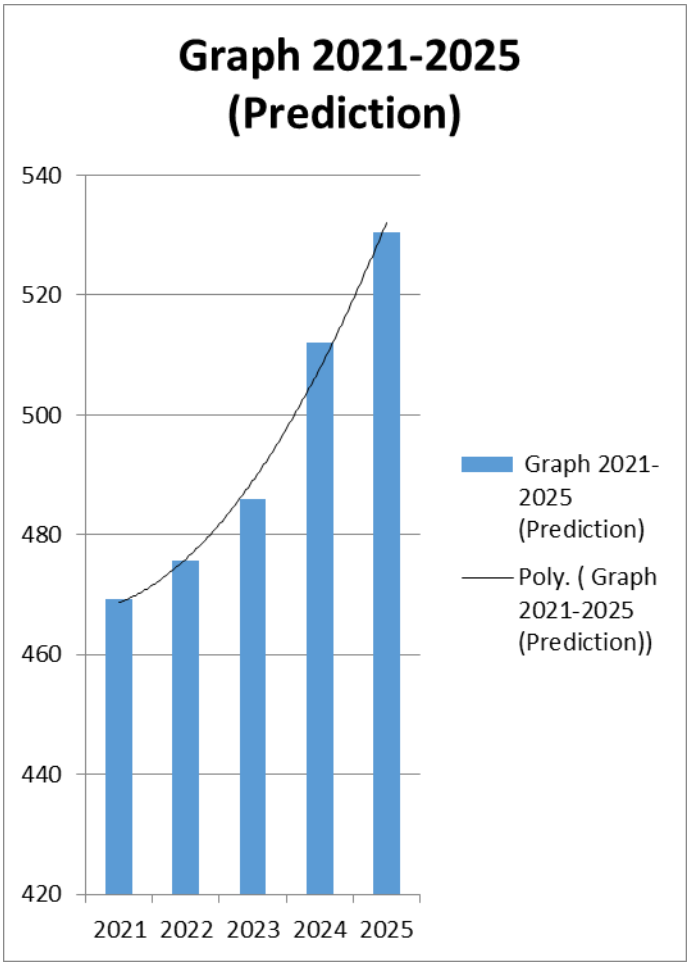
4.7 What benefits you are getting from this protocol in daily life?



Above diagram states individual getting benefit from this IEEE 802.11 wireless protocol. 70.7% feels that its Easy and Time saving, 61%-63% experienced its mobility feature and high data rates as well as some of them as opined Plug and Play, Portability factures of 802.11 wireless technology.

5. Result

Outcome for given survey: more than half of people are aware of IEEE 802.11 wireless standard its advantages, disadvantages and application in daily life. Now, with respect to development or adaptation of this technology, it is going to be the future in next coming years, it is beneficial for manufactures of 802.11 wireless devices also, as their sales are going to increase in next coming years. Below diagram is projection of development in coming years, here y-axis indicates population in millions and x-axis represents years from 2021 to 2025.



6. CONCLUSIONS

In a survey of more than thousand people, we got to know the general awareness regarding the 802.11 protocol. More than 68% of people are aware of benefits and use the technology for various applications like wireless printing. We also surveyed their consciousness of the current market price and companies which contrive the 802.11 n wireless LAN devices. Maximum people are very sure that Wi-Fi will soon become a necessity and the demand has and will continue to escalate rapidly in the years to come.

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