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A Detailed Exploration of Usability Statistics and Application Rating Based on Wireless Protocols

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Abstract: *A Detailed Exploration of usability statistics and Application Rating on short-range Wireless protocols Bluetooth (IEEE 802.15.1), ZigBee (IEEE 802.15.4), Wi-Fi (IEEE 802.11) and NFC (ISO/IEC 14443) has been performed that being representing of those prominent wireless protocols evaluating their main characteristics and performances in terms of some metric such as co-existence, data rate, security, power consumption, joining time are analyzed and presented. Furthermore, considering the file sharing, tag connection, payment method apply and security parameters, usability statistics, application rating and research output is also depicted so that one can easily identify the scope of the protocols, and can visualize the most trending and demandable wireless protocol. A deeply analyzed bar graph illustrates the most demandable wireless protocol . This can be applied in any user's work in the Wireless Network lab and also be implemented in any real-world applications for the appropriate components and devices among the protocols in proper fields.*

Keywords: *Bluetooth, Co-existence, Data Rate, Wi-Fi, ISM Band, NFC, Zig Bee.*

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I. INTRODUCTION

Bluetooth is otherwise called the IEEE 802.15.4 standard dependent on remote radio framework that empowers of gadgets to convey one another. It was initially created by Ericsson, later on 1998 it is being created by an organization consortium called Bluetooth Special Interest Group or basically SIG (Ericsson, Intel, Toshiba, Nokia and IBM). On 2008, at tenth commemoration Bluetooth SIG respects its 10000th individuals [1]. Bluetooth is a remote convention intended for short-run, low power and shabby gadgets to substitute links for mobile phones, PDA, sans hands Audio just as PC peripherals, i.e., mice, consoles, joysticks, and printers. Since Bluetooth was created for cell phone industry.

ZigBee over IEEE 802.15.4 is low information rate WPAN (LR-WPAN) structure exceptionally to supplant the multiplication of individual remote controls. ZigBee is foreseen to have the capacity to wipe out electric cabling in houses so permitting decision of remote light switches. It was intended to fulfill the market requirement for cost-productive standard based remote system that help low information rate, low

power utilization, security and dependability. Its mode for basic sending order, i.e., tuning on a TV or little piece of information, that is, climate an entryway is bolted. ZigBee will in general use far less power than other short range organizing advances. The battery life of ZigBee gadget can frequently be estimated in years, as opposed to hours on account of Wi-Fi or days with Bluetooth. Also ZigBee gadgets to consequently associate with and transmit information each other with experiencing a focal passage like a switch. ZigBee Alliance, an industry working gathering created application programming of IEEE 802.15.4 remote standard.

NFC (Near Field Communication) ISO/ IEC 14443 and ISO/IEC 18000-3 consumes the lowest power than other wireless technologies. It was started in the early of 1980s but the form in that time was RFID (Radio Frequency Identification). Charles Walton got the first credit for an object using the RFID technology in 1983[1].This technology allowed the user to send radio information to an identified receiver. It is an excellent technology for the purpose of using security tags in smart shops, cafe or any retail location. In this study, a comparative study of the four short range remote systems Bluetooth, ZigBee, Wi-Fi and NFC are studied, analyzed and presented along a chart with their applicability.

In this paper, it organized as follows: section II introduces the review of some similar previous studies and experiments. Section III discusses the comparison among the short range wireless communications and sections IV illustrates the discussion of results achieved. Finally section V delineates conclusions.

II. BACKGROUND STUDY

Bluetooth works on 2.4 GHz unlicensed ISM (Industrial, Scientific and Medical) band at a data rate of 720 Kbps. Different remote innovation, e. g., Wi-Fi and ZigBee and hardware, i.e., microwave, additionally shares a similar recurrence band. So as to maintain a strategic distance from obstruction, the Bluetooth detail utilizes Frequency Hopping Spread Spectrum (FHSS) strategies which separate the recurrence band into various channels. As should be obvious in Table I there are 79 physical channels each are 1 MHz, those Bluetooth may use for its bouncing calculation. Recurrence bouncing happens by hopping from one physical methods each physical channel is involved for term of 62μs. System scope of a Bluetooth gadget relies upon its yield control level. Bluetooth radio detail orders the Bluetooth gadgets into their classes dependent on their yield control. The Bluetooth control classes are given underneath: Class 1: in this class the most extreme yield control is 100mW (+20dBm) and the base yield control is 1mW (0 dBm) [2]. Many researches found the comparison of Bluetooth and Wi-Fi or Bluetooth, ZigBee and Wi-Fi [6] [7] [14] and about NFC, researchers are shown the performance of security enhancement, authentication scheme, IoT Application and mobile payment system. [17] [18] [19]. This paper a comparative study is shown all together of Bluetooth, Zigbee, Wi-Fi and NFC.

TABLE1. INTERNATIONAL BLUETOOTH FREQUENCY ALLOCATIONS

Area	Frequency Range	RF Channels (MHz)
U.S., most of Europe, and most of other countries.	2.4000 - 2.4835 GHz	F=2402+k, k=0,..,78
Japan	2.471 - 2.475 GH	F=2473+k, k=0,..., 22
Spain	2.445 - 2.475 GHz	F=2449+k, k=0,..., 22
France	2.465 - 2.4835 GHz	F=2454+k, k=0,..,22

Table1 illustrates worldwide country-based Bluetooth Frequency allocations and their allocated RF channels.It is probably aware that remote systems don't generally share any physical media, i.e., a typical link, it utilizes other approach to participate in a system. At the point when tow Bluetooth gadgets come quite close to one another can set up an impromptu system. Two availability topologies are characterized in Bluetooth: the Piconet and Scatternet. A Piconet is a Wireless Personal Area Network (WPAN) shaped by a gadget called ACE in the Piconet and at least one Bluetooth gadgets go about as slaves. A recurrence bouncing channel dependent on the location of the ACE characterizes each

Piconet. The gadgets those are taking an interest on the correspondence just, with their lord in a point-to-point way and may possibly impart when conceded authorization from ACE. ACE can impart either in point-to-point or point-to-multipoint. Additionally next to in a functioning mode, a slave can go sniff, hold or park mode to lessen control utilization. In a Piconet there could have at most eight gadgets, one go about as ACE and rest of them fills in as slaves. With the utilization of park mode, there could be in excess of seven slaves in a Piconet [3].

Bluetooth Version 2.0 + ERD: It is best form. It has in reverse similarity with variant 1.2 and progressively fit for recuperating mistake from rendition 1.2. It likewise presents upgraded information rate which utilized PSK tweak and has two variations: (π/4-DQPSK and 8DPSK. The gross air information rate for EDR is 2Mbps utilizing (π/4-DQPSK and 3Mbps utilizing 8DPSK. Bluetooth Version2.1+EDR: Architecture of Bluetooth 2.1 and 2.0 is practically same, 2.1 incorporates Secure Simple Paring. The essential objective of Secure Simple Paring is to make the blending method giggle and quicker. Auxiliary objective are to improve security of Bluetooth remote innovation. Secure Simple Pairing offers two kinds of security: assurance structure latent spying and insurance against man-in-the center (MITH) assaults (dynamic spying) [4]. Bluetooth 3.0+HS: It bolsters information rate roughly 24Mbps [5] Bluetooth low vitality gives a more prominent measure of knowledge in the controller which allows a host to rest for longer timeframe and be awoken up the controller just when the host needs to play out some activity [6].

The point of ZigBee innovation is to make a low obligation cycle sensor arrange (<1%). A gadget can associated recently with in 30ms. A dozing slave changing to dynamic and exchanging information by getting to a channel need around 15 ms individually. The benefits of ZigBee over Bluetooth and Wi-Fi is to quickly join data, disconnect, and rests mode, that makes ZigBee quicker and devour less power than different remote systems. Condition of activity is a rest mode exceptionally intended to oblige battery controlled gadgets. Any ZigBee-agreeable radio can change consequently to rest mode when it's not transmitting and stay snoozing mode until it needs to convey once more.

Contingent upon the allotted opening, called GTS that permits every gadget (security framework) a particular length of time as characterize by the PAN organizer in the superframe. Convention of ZigBee utilizes spread range method in the table II GHz band, which is unlicensed in many nations as the ISM (Industrial, Scientific and Medical) band. An aggregate of 27 channels [7], numbered 0 to 26, are accessible over the recurrence groups. 16 diverts are accessible in the 2450 MHz band, 10 in the 915 MHz band, and 1 in the 868 MHz band. The middle recurrence of this channel is characterized as pursues: Fc = 868.3 in megahertz, for n=0, Fc = 906+2 (n-1) in megahertz, for n= 1, 2, 3… 10, And Fc = 2450+5 (n-1) in megahertz, for n = 11, 12, 13… 26, where n is the channel number and the channel width is 2 MHz and 5 MHz channel dispersing.

TABLE 2. INTERNATIONAL ZIGBEE FREQUENCY ALLOCATION

Area	Frequency range (MHz)	RF Channels	Data Rate (Kbps)
Almost All Countries	24000-2438.5 (Global)	16	250
Europe	868-868.5	1	20
North America	902-928	10	40

Table 2 depicts worldwide regional based zigbee frequency allocations , RF channels and data rate. For each PHY upheld, an agreeable gadget will bolster all channels permitted by guidelines for the area in which the gadget works. The transmission separate is required to run 10 to 70+ miters, contingent upon the power yield and ecological qualities [9]. What's more, up to 1500m for ZigBee professional (2007 stack profile 2). The yield intensity of the radios is ordinarily 0 dBm refereed to 1 milliWatt (mW). As far as possible on power is characterized by the consistency commission of every nation. In the 2.4 GHz band, ZigBee utilizes DSSS (Direct Sequence Spread Spectrum) with counterbalance quadrature stage move keying (O-QPSK) where the image rate is 62.5. Both the 868 and 900 MHz band additionally use DSSS (Direct Sequence Spread Spectrum) with BPSK (Binary Phase-move Keying) balance and the image rate ought to be successively 20 and

40. ZigBee gives self-composed, multi-jump, and solid work organizing with low power. In a LR-WPAN (Low range remote individual territory arrange) organize two diverse gadget can take an interest [7] a Full Function Device (FFD) and a Reduced Function Device (RFD). The FFD has three working modes known as: an individual Area Network (PAN) facilitator, an organizer or a gadget. A FFD can converse with RFDs or different FFDs,

IEEE 802.11 standard was the primary standard depicting the task of remote LANs. This standard contained the majority of the accessible transmission advancements including DSSS, FHSS and working 2.4-5 GHz ISM (unlicensed) band at information rates for IEEE 802.11/b is 11Mbps, IEEE 802.11/a/g is 54 Mbps and IEEE 802.11/n is 200 Mbps. Infrared at 1 Mbps working at a wavelength somewhere in the range of 850 and 950 nm. IEEE 802.11a standard works 5 GHz band, OFDM adjustment procedure with 54 Mbps information rate. IEEE 802.11b standard backings up to 11 Mbps and it utilizes the 2.4 GHz recurrence with DSSS spreading system. IEEE 802.11g standard has OFDM method in the 2.4 GHz band with 54 Mbps information rate. There are 14 RF channels (13 in Europe and 1 in Japan) with 22 MHz data transmission. The IEEE 802.11 engineering comprises of a few parts to give a WLAN that help STA (Station) versatility straightforwardly to upper layer. The outlines the model created by the 802.11 working gathering. Basic Service Set (BSS) is the littlest square of WLAN, which comprises of some number of stations executing same MAC convention and going after getting access of same shared remote media. A BSS has a restricted inclusion for the reason for constrained radio medium. A Wi-Fi LAN can be stretched out by interconnecting number of BSS's. The interconnection is accomplished by a passage (AP) to a spine circulated framework (DS). In a BSS, the customer stations don't correspondence straightforwardly with one another. A station that needs to speak with another station inside the BSS, the MAC outline is first sent to passage then AP transfer it to the goal. In the event that all the station in a BSS is versatile station and has no association with different BSSs, the BSS is called autonomous BSS or IBSS. An IBSS basically a specially appointed system, every one of the stations can impart legitimately one another and there is no passageway. The DS and BSSs permit IEEE 802.11 to make remote system subjective size and unpredictability. This kind of system alludes to as expanded administration set (ESS). An ESS is the association of BSSs associated by a DS. ESS shows up as a solitary consistent LAN to the coherent connection control level (LLC). A gateway is utilized to incorporate IEEE 802.11 engineering with a conventional wired LAN. The entryway rationale is executed on a gadget, for example, scaffold or switch that is a piece of wired LAN and associated with disseminated framework.

RFID is the procedure by which things are extraordinarily recognized utilizing radio waves, and NFC is a specific subset inside the group of RFID innovation [15], [16]. In particular, NFC is a part of High-Frequency (HF) RFID, and both work at the 13.56 MHz recurrence. NFC is intended to be a protected type of information trade, and an NFC gadget is fit for being both an NFC per user and an NFC tag [13]. This extraordinary component permits NFC gadgets to impart distributed. NFC covers the lowest communication range among all other technologies. The communication range is less than 4cm.Usually it communicates between two devices by bringing them within 4 cm. usually, there are two communication terminals for NFC. The first one is initiator and the second one is the target. The initiator is the one who wishes to impart and begins the correspondence. The target gets the initiator's correspondence to ask for and sends back an answer. Keeps the target from sending any information without first getting a message. In the shared situation, NFC is utilized to empower correspondence between two gadgets with the goal that information can be transmitted locally between the two. In the event that the measure of data is moderately little (as much as one kilobyte), it is conceivable to utilize NFC to transmit the information itself. In any case, an increasingly normal distributed situation is probably going to be when NFC is utilized to set up another remote association technique, (for example, Bluetooth or (Wi-Fi) to convey the data to be shared. One case of this sort of utilization is the point at which a client has taken a progression of photographs utilizing a camera versatile or computerized camera, and needs to print them

out.

NFC frameworks are, in this way, picking up significance in the Internet of Things (IoT) situation. NFC is additionally intriguing for the advancement of minimal effort sensors since it gives a fast and simple method for getting information from them just by moving toward the per user to the tag without blending the gadgets. The up and coming fifth era (5G) of correspondence innovation is required to release a huge IoT biological system where systems can serve the correspondence needs for billions of associated gadgets, with the correct exchange offs between speed, inactivity, and cost. RFID is one of the most vital advancements for the enormous sending of IoT. It can bring IoT to unpowered objects with its capacity to interface the detached. What's more, NFC can put IoT gadgets under a client's control and is anything but difficult to use with its "tap-and-go" nature. Specifically, green NFC sensors dependent on vitality reaping can help in the structure of another age of minimal effort savvy wearables and in the improvement of the man– machine interface, which opens the way to helpful IoT for keen urban communities furthermore, Industry 4.0 applications [19].

TABLE 3. SUMMARY OF NFC RF SIGNAL CODING AND MODULATION

Data Rate (Kbps)	Active Devices	Passive Devices
106	Modified Miller, 100%, ASK	Manchester, 10%, ASK
212	Manchester, 10%, ASK	Manchester, 10%, ASK
424	Manchester, 10%, ASK	Manchester, 10%, ASK

Table 3 summarize the NFC RF signal coding and modulations where data rate , active and passive devices are showed with percentage.

III. COMPARISON OF BLUETOOTH, ZIGBEE, WI-FI AND NFC

There are a lot of technical differences and similarities present among Bluetooth, ZigBee and Wi-Fi. The main difference includes data rate, power consumption, network size, cost distance coverage and security.

1. RF Channel and Coexistence

These four remote systems utilize all inclusive 2.4-5 GHz ISM band and spread range innovation. Bluetooth utilizes recurrence bouncing spread range (FHSS) and parts 2.4 GHz band into 79 RF channels and every one of them 1 MHz data transmission. ZigBee utilizes direct grouping spread range (DSSS) and works in three diverse radio frequencies relying on topographical regions, for example, 868 MHz band (in Europe), 915 MHz (in North America) and 2.4 GHz band (Worldwide). In ZigBee 2.4 GHz ISM band is separated into 16 RF channel with 2 MHz transmission capacity; focused at 5 MHz one another and there is 2 MHz hole between two sequential channels. Wi-Fi, the IEEE 802.11 family is a lot of standard, for example, 802.11a, 802.11b, 802.11g and 802.11n, etc. Both 802.11b and 802.11g works in 2.4-5 GHz band utilizes direct succession spread range (DSSS) and symmetrical recurrence division multiplexing (OFDM) individually [14]. Then again 802.11a utilizations OFDM and works in 5 GHz transfer speed. 802.11b and 14 RF channels (11 in North America, 13 in Europe and 1 in Japan) each are separated 5MHz separated with 22 MHz in data transmission, however the majority of them are over-laps one another. There are just 3 non-covering channels (commonly 1, 6 and 11). 802.11a gives up to 23 non covering channels. Since Bluetooth, ZigBee and Wi-Fi utilizes 2.4 GHz band so there must have recurrence impedance (crash), to limit obstruction among them diverse specialized technique and proposal have been made. To dodge impedance somewhere in the range of 802.11 and 802.15.4 Schneider Electric's Innovation Department proposed two establishment methods [11]. Separation of Wi-Fi interferers to ZigBee hubs ought to be no less than 2 m. Recurrence balance between the two systems ought to be no less than 30 MHz. As indicated by their test setup daintree Networks says IEEE 802.11g systems have less effect on ZigBee than IEEE 802.11b systems because of less time spent on air. In particular, NFC is a part of High-Frequency (HF) RFID, and both work at the 13.56 MHz recurrence [15] and uses unlicensed ISM band. NFC is intended to be a protected type of information trade, and an NFC gadget is fit for

being both an NFC per user and an NFC tag. . NFC utilizes two diverse coding frameworks on the RF signal to exchange information. As a rule, a dimension of 10% regulation is utilized, with a Manchester coding group.

2. Network Size

In a Bluetooth Piconet there can be at most 8 dynamic gadgets (1 ACE and 7 slaves) however at park mode there could be in excess of 8 gadgets. In a ZigBee star organize there could be in excess of 65000 gadgets and for an organized Wi-Fi BSS there may have 2007 gadgets. However, these three conventions bolster complex systems administration, for example, Scatternet of Bluetooth, bunch tree or work organizing ZigBee and broadened administration set in Wi-Fi. Usually, and there are two communication terminals for NFC. The first one is initiator and the second one is the target. The initiator is the one who wishes to impart and begins the correspondence. The target gets the initiator's correspondence to ask for and sends back an answer. Keeps the target from sending any information without first getting a message.

3. Network Joining Time

In a Bluetooth Piconet new slave joining time is 3 seconds, normally 20 seconds and a dozing slave changes to dynamic in 3 seconds and channel get to time of a functioning slave is 2 milliseconds. Then again in ZigBee new gadget joining time is commonly 30 milliseconds, dozing slave changes to dynamic in 15 milliseconds and dynamic channel get to time is normally 15 milliseconds. For Wi-Fi, a gadget takes 3 seconds to participate in a system. With NFC, rather than performing manual designs to recognize gadgets, the association between two NFC gadgets is naturally settled in under 0.1 second.

4. Communication Range and Output Power

The transmission separation of ZigBee is from 10 to 70+ meters relying on the yield control and natural qualities though Bluetooth and Wi-Fi is from 10 to 100 meters and 100 meters separately. The separation of Bluetooth relies on the power classes. The yield intensity of the radios of ZigBee is typically 0 dBm refereed to 1 milli Watt (mW) and the most extreme power yield keeps up the administrative commission of every nation. For Bluetooth most extreme yield control is 100mW (+20dBm) and the base yield control is 1mW (0dBm). In the Wi-Fi the ostensible yield control is 20 dBm methods 100 mW. NFC covers the lowest communication range among all other technologies. The communication range is less than 4cm.Usually it communicates between two devices by bringing them within 4 cm.

5. Data Rate and Power Consumption

Bluetooth speak to 720 Kbps information rate and the pinnacle information rate is 1Mbps though Bluetooth 3.0 + Hs underpins information rate around 24Mbps, works with huge bundle gadgets, higher information rate and higher power utilization than ZigBee. Interestingly ZigBee speaks to 250 kbps information rate and the image rate is 62.5[14]. It has low information rate, low power utilization and works with little parcel gadgets. Furthermore, for Wi-Fi the information rate is 54-200 Mbps, higher information rate, higher power utilization than Bluetooth and ZigBee, to a great extent used to give rapid to the web access or neighborhood. Wi-Fi gives higher throughput and spreads an extraordinary separation and need higher power utilization then again ZigBee and Bluetooth give lower throughput and need low power utilization and the most extreme information exchange rate of NFC is 424 kbps [18].

6. Security

Any remote standard is incorporated encryption, key administration, and verification strategy. Bluetooth utilizes the E0 stream figure and CRC-16 while ZigBee security dependent on 128-piece Advanced Encryption standard (AES) for encryption with counter mode (CTR) and 32-bit Message Integrity code (MIC) to guarantee message freshness. In Wi-Fi utilized RC4 stream figure for encryption and CRC-32 is utilized for honesty. Any Wired Equivalent Protection (WEP) utilizes a solitary encryption key for all gadgets and parcels yet WEP isn't sheltered, it tends to be broken in around one moment. Wi-Fi ensured Access (WAP) was planned so as to supplant WEP

as a result of its shortcoming. The IEE standard created Wi-Fi secured Access2 (WAP2), I. e. IEEE 802.11.i past WEP and chose to utilize Advanced Encryption standard (AES) for encryption which works in a counter mode (CTR). Likewise WAP2 utilizes a 128-piece key for universally handy (encryption and honesty), of which figure square Chaining message confirmation code (CBC-MAC) is utilized. NFC joins AES and DES/ Triple-DES encryption principles, just as more established exclusive encryption calculations [21].

The performed comparative Analysis of Bluetooth, ZigBee, Wi-Fi and NFC are summarized and presented in Table 4.

TABLE4. COMPARISON AMONG BLUETOOTH, ZIGBEE, WI-FI AND NFC

Standard	Bluetooth	ZigBee	Wi-Fi	NFC
IEEE Specification	802.15.1	802.15.4	802.11a/b/g/ n	ISO/IEC 14443 and ISO/IEC 18000-3
Frequency Band	2.4 GHz	868/915 MHz-2.4 GHz	2.4 GHz, 5,6 GHz	13.56 MHz
Max Data Rate	3 Mbps	250 Kbps	200 Mbps	424 kbps
Packet Length	1024 Bytes, 8-27 Bytes (BTLE)	22 Bytes	1024 Bytes	1 Byte
Distance Coverage	10 m	10-100 m	100 m	4 cm -10 cm
Battery life	Regular charging	1+ year	Hourly charging	Regular charging
Nominal TX Power	0-10 dBm	(-25)-0 dBm	15-20 dBm	+20 dBm (100 mW
Number of RF Channel	79	1, 10, 16	14, 23	10% regulation is utilized, with a Manchester coding group
Bandwidth Modulation Scheme	1 MHz GRSK	2 MHz BPSK (+ASK), O-OPSK	22 MHz BPSK, OPSK, COFDM, CCK, M-QAm	460 [KH_z] ASK
Coexistence Mechanism	AFH	Dynamic Frequency Selection	Dynamic Frequency Selection, Transmit power control	Use difference frequency band
Basic Cell Extended Cell	Piconet Scatternet	Star Cluster Tree and Mesh	BSS ESS	Peer-to-peer Peer-to-peer
Max Number of Nodes	8	65000	2007	2
Encryption	E0 Stream Cipher	AES Block Cipher (CTR, counter mode)	RC4 stream cipher (WEP), AES block cipher	AES and DES
Authentication	Shared Secret	CBC-MAC (CCMP)	WPA2 (802.11.i)	Special Key is Used
Data protection	16-bit CRC	16 bit CRC	32-bit CRC	-
Protocol Complexity	High	Low	Medium	Medium
Cost	Medium	Low	High	Medium
Network Joining Time	3 second	30 millisecond	3 second	0.1 second

Table 4 shows the comparison among Bluetooth Zigbee ,Wi-Fi and NFC based on their distance coverage ,IEEE specifications, Frequency band, Max data rate and so on.

IV. RESULT AND DISCUSSION

The data rate, power consumsion, joining time and distance coverage of the four prominent wireless technologies: the Bluetooth, ZigBee, Wi-Fi and NFC are graphically presented in Fig. 1.

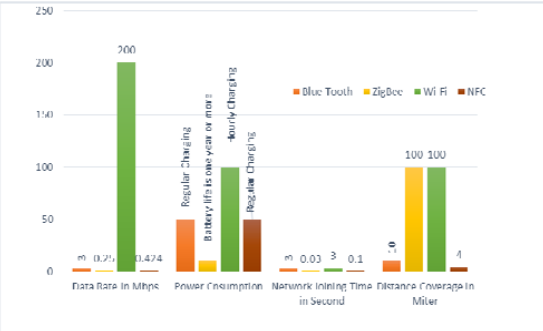

Figure 1. Several Comparisons of Each Protocol

When refering to Fig. 1, it is helpful to place comparision measurement into several distinct senario of the protocols. Wi-Fi provides haigh data rate, consums high power and cover long distance (except ZigBee) than others protocols. Also network joining time of Wi-Fi and Bluetooth are same e.g 3 seconds whether ZigBee and NFC protocols take lowest time to join network accordingly. Table 5 summaries the applicability of the four widely used short range Wireless protocols.

4.1. USABILITY STATISTICS

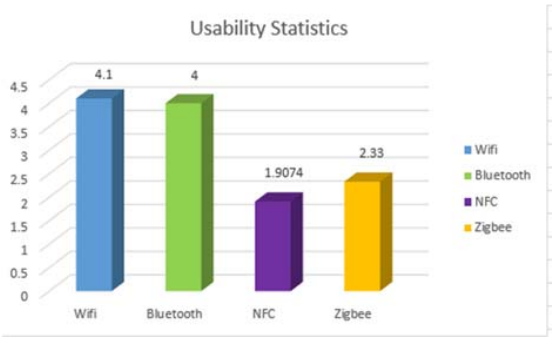

Figure 2. Several Comparisons of Each Protocol

When figure2 is noted that is expressed the usability statistics and application rating among all those wireless protocols. Wi-Fi and Bluetooth have the highest usability because of their avalabality and consumer demand. In Table 5 is shown that these two protocols are mainly used for file sahring though they are unsafe. On the other hand, another two protocols have low usability than the previous two in terms of their communication system. It is shown in Table 5 that these two protocols are primarily used for device to device connection and payment system and though NFC is safe.

TABLE5. A COMPARISON CHART OF APPLICABILITY

Methods	File Sharing	Tag Connection	Payment Method Apply	Security
Bluetooth	Yes	No	No	Unsafe
ZigBee	No	No, (Device Control)	No	Unsafe
Wi-Fi	Yes	No	No	Unsafe
NFC	Yes with tag sharing	Yes	Yes	Safe and Designated Security

Table 5 shows that File sharing cannot done with ZigBee but can be done with Bluetooth, Wi-Fi and NFC, but NFC also perform tag sharing. Tag connection can only be happen with NFC. Only NFC can be applied for payment method with a safe security.

V. CONCLUSION

The four short range remote systems Bluetooth, ZigBee, Wi-Fi and NFC are studied, analyzed and their usability statistics are presented. Those four remote guidelines that contains the mechanical diagram, information encoding framework, arrange definition, radio recurrence, control yield framework and the other part is a similar report concerning information rate, control utilization, control yield, correspondence extend, security, organizing, ability, concurrence and recurrence run. The distinctions among these remote measures rely upon the structure of engineering fabricating. It is a matter of fact that these four remote innovation utilizing a similar radio recurrence (ISM) band yet they contain distinctive qualities from the purpose of mechanical uses and configuration too. As indicated by the utilization of these four remote systems are vital of their own innovative angle and the usability statistics depicts the consumer demand. Bluetooth isn't reasonable for work organize, it depends on star topology can convey a normal number of Bluetooth gadgets with focal gadget, what can include the gadget with the system or drop the association off. ZigBee contains work topology can cover a vast territory and hubs can impart to the PAN facilitator however any hub is tumbled down, yet this innovation in very little suitable for specially appointed system. Again, Wi-Fi utilizes get to based (AP) topology; customer can impart through Ap. In the event that AP drops the customers are not ready to transmit information. It is reasonable for impromptu system, customer gadgets inside a range can discuss straightforwardly with one another. NFC Usually, there are two correspondence terminals for NFC. The first is initiator and the second one is the objective. The initiator is the person who wishes to confer and starts the correspondence.

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