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Evaluation of Gi-Fi(Gigabit Fidelity) Technology for Future of High-Rate Wireless Communication

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Abstract: Gi-Fi is one of the most important wireless technology that enhances our personal environment, either work or private, by means of networking or a variety of personal and wearable devices within the space and with the outside world. In optical fibers, Gi-Fi played an important role for its high speed large files transfers within seconds. It is a scalable wireless platform for constructing alternative and complementary broadband networks and it operates at 60 GHz on the CMOS process. It will also allow the transfer of wireless audio and video files within a range of 10 meters. The installation of cables in optical fiber caused a greater difficulty and thus led to wireless access. Initially wireless technology includes infrared which was a very slow technology further inventions were done to make wireless technology a better for communication and the invention of Bluetooth, WI-MAX moved wireless communication to a new era.

Keywords: CMOS (Complementary Metal Oxide Semiconductor), Millimeter-Wave, Time-Division Duplex.

I. INTRODUCTION

Communication is one of the key parts of science that has always been a crucial point for exchanging information among parties at locations bodily apart. As there is no current developments which transfer data at faster rate, as video information transfer taking lot of time. This leads to introduction of Gi-Fi technology. It delivers faster information rate in Gbps, less power consumption and low cost for short range transmissions. Gigabit Wireless is the world's first transceiver integrated on a single chip that operates at 60GHz on the CMOS (Complementary Metal–Oxide– Semiconductor) process. It will permit wireless transfer of audio and video data up to 5 gigabits per second, ten times the current maximum wireless transfer rate, at one-tenth of the cost, usually within a range of 10 meters [1]. It makes use of a 5mm square chip and a 1mm wide antenna burning less than 2milli watts of power to transmit data wirelessly over short distances, much like Bluetooth. With the help of Gi-Fi chips the videos sharing can be possible without any difficulties. The Gi-Fi chip is one of Australia's most productive technologies. The new gigabit wireless system presents Multi-gigabit wireless technology that eliminates the need for cables between consumer electronic devices. This technology with high level of frequency re-use can declare the communication needs of multiple consumers in a small geographic region.

II. LITERATURE SURVEY

S. Dheeraj and S. Gopichand et.al, 2002 [1] proposed a model in which they implement a technology which gain flexibility of infrastructure, reduce capital expenditure, gain advantages over competitors and to solve business problems. Gowtham S Shetty et.al, 2006 [2] proposed that wireless dual band router and wireless dual band USB adapter are based on the next generation Wi-Fi technology, which is a new wireless computer networking standard in the 802.11 ac family. Ross and John et.al, 2007. Proposed a model that MIMO (Multiple input Multiple output) increase the capacity 10 times or more and simultaneously improve the radiated energy efficiency of the order of 100 times and the system enables significant reduction of latency on the radio interface using the low numbers and be forming in order to avoid feeding pipes. Sachin Abhyankar et.al, 2009 [4] proposed a model that the introduction of Wi-Fi wireless network has proved a solution to Bluetooth problem, the limitations for data exchange rate and range. Ramirez et.al, 2011 [5] proposed that the radio links can be operated in indoor environments with low power transmission and with reduced fading margin, making ultra-wide band systems good as shown in Fig.1.

III. EVOLUTION OF NETWORK

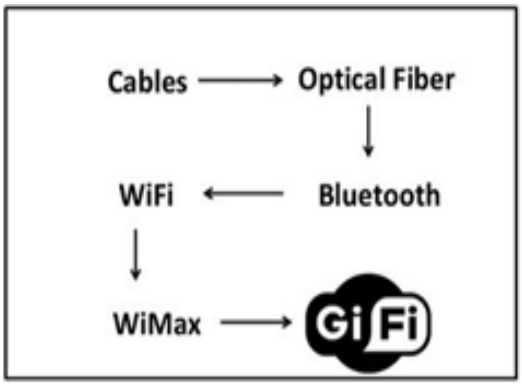

Fig.1. Network Evolution.

A. WI-MAX

There are wireless broadband systems that offer fast web surfing without being getting connected through cable. Although WI-MAX Can potentially deliver data rates of more than 30 megabits per second, yet it provides offer average zero data rate of 6 Mbps and often deliver less, making the service significantly slower than the hard-wired broadband [2]. The actual cost of the data available using WI-MAX transmitting station would send data to WI-MAX enabled computers or routers as shown in Fig. 2.

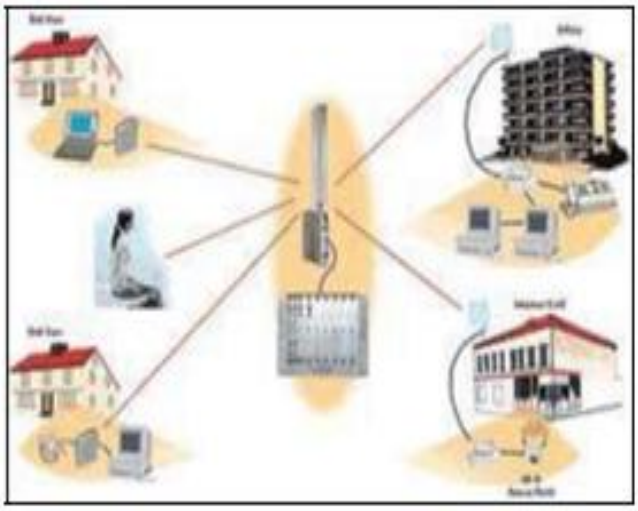

Fig.2.WI-MAX.

B. Gi-Fi

Gi-Fi or gigabit wireless is the world's first transceiver integrated on a single chip that operates at 60GHz on the cmos process. It will allow wireless transfer of audio and video data at up to 5gigabits per second, ten times the current maximum wireless transfer rate, at one- tenth the cost. NICTA researchers have chosen to develop this technology in the 57-64GHz unlicensed frequency band as the millimeter-wave range of the spectrum makes possible high component on-chip integration as well as allowing for the integration of very small high gain arrays. The available 7GHz of spectrum results in very high data rates, up to 5 gigabits per second to users within an indoor environment, usually within a range of 10 meters .It satisfies the standards of IEEE 802.15.3C. A new silicon chip developed in Melbourne is predicted to revolutionize the way household gadgets like televisions, phones and DVD players talk to each other as shown in Fig.3. The tiny five- millimeter-a-side chip can transmit data through a wireless connection at a breakthrough five gigabits per second over distances of up to 10 meters. An entire high-definition movie could be transmitted to a mobile phone in a few seconds, and the phone could then upload the movie to a home computer or screen at the same speed. This means his team is ahead and stood in front of the competition in terms of price and power demand. His chip uses only a tiny one-millimeter-wide antenna and less than two watts of power, and would cost less than $10 to manufacture.

Fig.3.Gi-Fi.

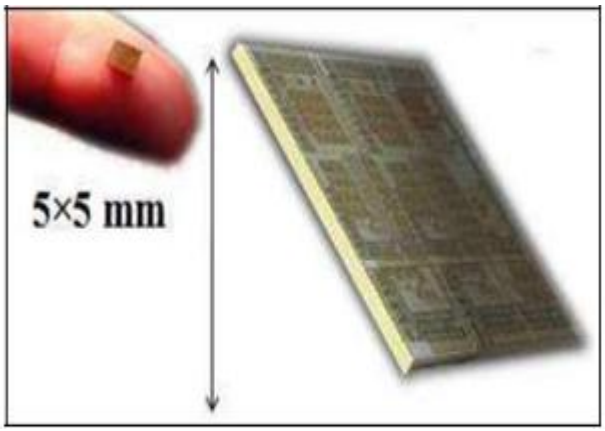

Fig.4.

C. What Is Gi-Fi

Gi-Fi or gigabit wireless is the world's first transceiver integrated on a single chip that operates at 60GHz on the CMOS process. It will allow wireless transfer of audio and video data at up to 5gigabits per second, ten times the current maximum wireless transfer rate, at one- tenth the cost. NICTA researchers have chosen to expand this technology in the 57-64GHz unlicensed frequency band as the millimeter-wave range of the spectrum creates possible high component on-chip integration as well as allowing for the integration of very small high gain arrays. The available 7GHz of spectrum results in very high data rates, up to 5 gigabits per second to users in an indoor environment, typically within a range of 10 meters. It assures the standards of IEEE 802.15.3C.The Gi-Fi chip contains a tiny amplifier; a bandpass filter, which admits only signals of the suitable frequencies; and a switch that isolates the transmitter and receiver so that they do not interfere with each other. The processor employs a 1-mm-wide integrated antenna and would cost about $10 to make. Gi-Fi transmits data at up to 5 Gbits per second over distances up to 10 meters. Wi-Fi transmits data at up to 54 Mbits per second over distances up to 100 meters. Gi-Fi uses 2.5-GHz-wide channels at frequencies between 57 and 64 GHz and transmits on wavelengths 5 mm wide. Wi-Fi typically uses 20- MHz-wide channels in the spectrum between 2.4 and 2.483 GHz, with wavelengths 12 cm wide [2]. Because Gi-Fi's wavelengths are smaller, the size of the system's components can also be smaller. The technology utilizes high-output power

amplifiers that boost the antennas' capability to capture the signal and thereby improve data rates. The researchers also added high-gain transmitters and receivers, which use narrow beams to better focus signals to further improve the data rate and range. However, its smaller antennas capture less energy and thus transmit over a shorter range.

IV. WORKING PRINCIPLE USED IN GI-FI

In this we will use time division duplex for both transmission and receiving. Here data files are up converted from IF range to RF60Ghz range by using 2 mixers and we will feed this to a power amplifier, which feeds millimeter wave antenna. The incoming RF signal is first down converted to an IF signal cantered at 5 GHz and then to normal data ranges. Here we will use heterodyne construction for this process to avoid leakages due to direct conversion and due to availability of 7 GHz spectrum the total data will be will be transferred within seconds.

A. Time -Division Duplex

Time-Division Duplex (TDD) is the application of time-division multiplexing to separate outward and return signals. It emulates full duplex communication over a half duplex communication link. As uplink traffic increases, more channel capacity can dynamically be allocated to that, and as it shrinks it can be taken away as shown in Fig.5.

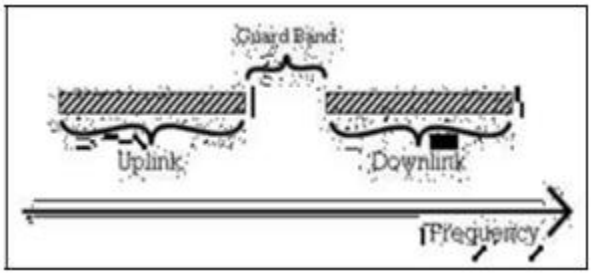

Fig.5.TDD.

Time division duplex (TDD) refers to duplex communication links where uplink is separated from downlink by the allocation of different time slots in the same frequency band. It is a transmission scheme that allows asymmetric flow for uplink and downlink data transmission. Users are allocated time slots for uplink and downlink transmission. This method is highly advantageous in case there is an asymmetry of uplink and downlink data rates. TDD divides a data stream into frames and assigns different time slots to forward and reverse transmissions, thereby allowing both types of transmissions to share the same transmission medium.

Multiple Input Multiple Outputs: MIMO wireless is an emerging cost effective technology that offers substantial leverages in making 1Gbps wireless links a reality. We can in principle, meet the 1Gbps data rate requirement if the product of bandwidth (measured in Hz) and spectral efficiency (measured in bps/Hz) equals 10^9. MIMO wireless constitutes a technological breakthrough that will allow Gbps speeds in NLOS wireless networks. The performance improvements resulting from the use of MIMO systems are due to

- Array gain
- Diversity gain
- Spatial Multiplexing Gain
- Interference Reduction

System-On-A-Package: SOP approach for the next-generation wireless solution is a more feasible option than SOC. Recent development of materials and processes in packaging area makes it possible to bring the concept of SOP into the RF world to meet the stringent needs in wireless communication area. Wireless devices implementing complex functionality require a large amount of circuitry and consequently, require a large conventional package or MCM real estate. SOP goes one step beyond Multi Chip Module (MCM) by enhancing overall performances and adding more functionality.

B. Operation At 60 Ghz

Here we will use millimeter wave antenna which will operate at 60 GHz frequency which is unlined band Because of this band we are achieving high data rates energy propagation in the 60 GHz band has unique characteristics that make possible many other benefits such as excellent immunity to co-channel interference, high security, and frequency re-use. Point-to-point wireless systems operating at 60 GHz have been used for many years for satellite-to-satellite communications. This is because of high oxygen absorption at 60 GHz (10-15 dB/Km). As shown in the figure 5.1.1 the absorption attenuates 60 GHz signals over distance, so that signals cannot travel far beyond their intended recipient. For this reason, 60GHz is an excellent choice for covert communication.

Ultra Wide Band Frequency Usage: A technology with high bit rate, high security and faster data transmission. It is a zero carrier technique with low coverage area. So we have low power consumption. These features are Ultra-Wideband is a technology for transmitting information spread over a large bandwidth (>500 MHz) that should, be able to share spectrum with other users. Regulatory settings of FCC are intended to provide an efficient use of scarce radio bandwidth while enabling both high data rate personal-area network (PAN) wireless connectivity and longer-range, low data rate applications as well as radar and imaging systems.

Features:

- High level of frequency re-use enabled – communication needs of multiple customers within a small geographic region can be satisfied.
- It is also highly portable-we can construct where ever we want.
- It deploys line of sight operation having only shorter coverage area, it has more flexible architecture.
- Multi-gigabit wireless technology that removes the need for cables between consumer electronic devices.
- More than 100 times faster than current short-range wireless technologies.

- Allows wireless streaming of uncompressed high-definition content.
- Operates over a range of 10 meters without interference.
- Entire transmission system can be built on a cost effective single silicon chip.

C. Architecture of Gi-Fi

The core components of a Gi-Fi system is the subscriber station which accessible to several access points. It supports standard of IEEE 802.15.3C supports millimeter-wave wireless pan network used for communication among computer devices close to one person. An 802.15.3C based system frequently uses small antenna at the subscriber station. The antenna is mounted on the roof. It supports line of sight operation.

D. Working Principle used in Gi-Fi

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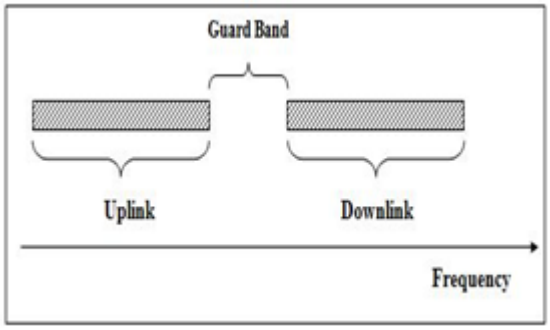

Fig.6. Time-Division Duplex.

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Operation at 60 GHz: 60 GHz transmission technology is a quite new wireless communications conception that intends to use the 7 GHz of bandwidth existing in the 60 GHz unlicensed band. The main advantages of this high-frequency-range technology are that it enables high data rates and short-range communication applications such as data transfer and uncompressed audio and video (A/V) transmissions. Data rates beyond 1 Gbit/s at up to 10 meters are feasible. These high data rates can be achieved because of the continuous spectrum and a less power-restricted bandwidth available in the 60 GHz band. Moreover, high path loss enables a better frequency reuse factor per indoor environment.

E. Analysis

Gi-Fi wireless technology has been developed and can be a tremendously fast substitution for technologies such as Bluetooth and Ultra-Wide Band (UWB). The method of Gi-Fi would employ a chip that transmits at an enormously high 60GHz frequency versus the 5GHz used for the fastest forms of Wi-Fi. Mixing and signal filtering used in Gi-Fi technology would maintain the signal strong versus the longer-ranged except slower and more drop-prone Wi-Fi option of today. The chip in Gi-Fi would probably cost about $10 or less to build. In modern years, new wireless local area networks (WLANs) such as Wi-Fi and wireless personal area networks (WPAN) such as Bluetooth have become accessible. Table1 compares different options of these different systems.

TABLE I: Comparison of Gi-Fi and Existing Technologies

Characteristics	Wireless Technologies		
	Bluetooth	Wi-Fi	Li-Fi
Specification Authority	Bluetooth SIG	IEEE, WECA	NICTA
Development Start date	1998	1990	2004
IEEE Standard	IEEE 802.15.1	IEEE 802.11.x	IEEE 802.15.3C
Power Consumption	5mW	10mW	<2mW
Data Transfer Rate	800 Kbps	11 Mbps	5 Gbps
Network Range	10 m	30 to 100 m	100 m
Operating Frequency	2.4 GHz	2.4 GHz, 5 GHz	57-64 GHz
Primary Devices	Mobile phones, PDAs, Consumer, Electronics Office, Industrial automation Devices	Notebook Computers, Desktop Computers, Servers	Mobile phones, Home Devices, PDAs, Consumer, Electronics Office Industrial automation Devices

Table 1 demonstrates the large power consumption associated with Wi-Fi and Bluetooth technologies in contrast to Gi-Fi. Wi-Fi needs 10mili watts and Bluetooth needs 5mili watts when Gi-Fi requiress less than 2mili watts [7, 8]. Data transfer rate of Wi-Fi is up to 11 Megabit per second and Bluetooth has 800 kilobits per second while Gi-Fi is able to transmit the data at the rate of 5 Gigabit per second. Wi-Fi and Bluetooth are operating in the frequency of 2.4 Giga Hertz but Gi-Fi uses the 60GHz millimeter wave spectrum to transmit the data, which bestows it a benefit over Wi-Fi. Wi-Fi's part of the spectrum is increasingly crowded, sharing the waves with devices such as cordless phones, which leads to interference and slower speeds. We can wind up that the Gi-Fi is a suitable technology for short distance data transmission to be used in various devices and places.

V. ADVANTAGES OF GI-FI

This Gi-Fi technology permits wireless uncompressed high definition content and operates over a range of 10 meters without interference. Gi-Fi chip has flexible architecture. It is highly convenient and can be constructed in all over the place. The complete transmission system can be built on a cost effective single silicon chip that operates in the unlicensed, 57-64 GHz spectrum band. Gi-Fi technology also facilitates the future of information management, is simple to employment with the small form factor. The most significant benefits of the Gi-Fi technology can be recapitulated as follows:

Capacity of High Speed Data Transfer: The data transfer rate of Gigabit wireless technology is in Gigabits per second. Speed of Gi-Fi is 5 Gbps; which is 10 times the data transfer of the existing technologies. Providing higher data transfer rate is the major invention of Gi-Fi. A complete High-Definition (HD) movie could be transmitted to a mobile handset in a few seconds, and the handset could then upload the movie to a home computer or screen at the similar speed.

Large Bandwidth: 60 GHz transmission technology is a quite fresh wireless communications idea that intends to use the 7 GHz of bandwidth existing in the 60 GHz unlicensed band.

No Interference: It utilizes the 60GHz millimeter wave spectrum to transmit the data, which offers it an benefit over Wi-Fi. Wi-Fi's part of the spectrum is increasingly crowded, sharing the waves with devices such as cordless phones, which leads to interference and slower speeds. But the millimeter wave spectrum (30 to 300 GHz) is about unoccupied, and the new chip is hundreds of times faster than the average home Wi-Fi technology.

Low Power Consumption: Power consumption of the current technologies such as Wi-Fi and Bluetooth are 5mili watts and 10mili watts but chip of Gi-Fi employs a small one-millimeter-wide antenna and it has less than 2mili watts of power consumption that in contrast to the existing technologies is very less.

Provides High Security: Gi-Fi technology is based on IEEE 802.15.3C and this standard gives more security as it gives optional security in the link level and service level. Point-to-point wireless systems operating at 60 GHz have been used for several years by the intelligence community for high security communications and by the military for satellite to satellite communications.

VI. APPLICATIONS OF GI-FI TECHNOLOGY

Gi-Fi offers a wide number of applications in today's scenario. Let us take a look of these applications:

Household Appliances: As the Gi-Fi used in vast number of household appliances such as in cellular phones and home theatre TVs and the consumers can download their movies and video songsand many other applications of their use in a matter of seconds and save it anywhere whenever they desired to use [4]. It offers a higher speed of internet and bandwidth, higher downloading speed, wireless data and real time streaming as shown in Fig.7.

Fig.7. Household Appliances.

Inter- Vehicle Communication: Gi-Fi technology uses a wide number of applications in inter-vehicle communication systems as itenables the vehicles to stay connected and go and it also offers better speed of vehicles in advent of communication syste. The data exchange between vehicles is made possible by ad-hoc networks.

Wireless PAN Networks: With the current technologies, the use of Gi-Fi in wireless PAN networks can take a better perspective in today's technology as the data files are transferred to RF 60GHz range by making use of two mixers from an IF(Intermediate Frequency) . The output is then stored in a power amplifier, that stores a millimeter wave antenna within. Due to a higher availability of 7 GHz spectrum, it results in higher data rates in a number of networks as shown in Fig. 8.

Fig.8. Wireless PAN Networks.

VII. GI-FI ACCESS DEVICES

Within 5 years, we will expect Gi-Fi to be dominant technology for wireless networking. Gi-Fi can bring wireless broadband and to the enterprise in an entirely better way which will develop wireless home and office of future as shown in Fig.9. The Gi-Fi team is looking for partners who are interested in commercializing its 60 GHz chips and with growing features of wireless technology it can be predicted that worldwide market for this technology is vast as it uses a number of high speed data transfer rates and no to its cost efficient technique and high portability many companies will be going to launch the chip.

Fig.9. Representation of GI-Fi Access Devices.

VIII.CONCLUSION

The wireless communication already contributed a gigantic revolt in the telecom sectors from the last three decades. Gi-Fi has given and it is clear that more research should be done in the field of this latest wireless technology and its applications. The Bluetooth which covers 9-10mts range and Wi-Fi followed 91mts. No doubt introduction of Wi-Fi wireless network has showed a inventive solution to bluetooth dilemma the standard original limitations for data exchange rate and range, number of chances, high cost of infrastructure have not so far possible for Wi-Fi to turn into a power network, then towards this dilemma the better technology in spite of the advantages of rate current technologies directed to the introduction of new, more up to date for data exchange that is GI-FI. The comparison is performed between Gi-Fi and existing wireless technologies illustrates that these features along with some other benefits that make it appropriate to replace the existing wireless technologies. It removes cables that for many years ruled over the world and presents high speed data transfer rate. Gi-Fi technology has much number of applications and can be used in various places and devices such as smart phones, wireless pan networks, media access control and mm-Wave video-signals transmission systems.

IX. ACKNOWLEDGMENT

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