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Comparative Study of Wireless Fidelity (Wi-Fi) and Gigabit Fidelity (Gi-Fi)

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Abstract **– The wireless technology has obviously taken over due to easy portability, increased productivity and accessibil--ity. Despite the advantage of this present technologies, early wireless technologies such as infrared and Bluetooth was quite slow which led to a better invention, the Wi-MAX. The undying thirst and quench for more leads to the new emerging technology Gigabit Fidelity (Gi-Fi). Gi-Fi is also a wireless technology which helps in accessing information whenever and wherever required. Gi-Fi is one of the fastest wireless technologies which transmit videos and audio in seconds within a range of 10meters. This paper examines the Gi-Fi wireless technologies. It also compares it with other wireless technologies and show why Gi-Fi is better than others.**

Keywords **– Gigabit Fidelity, Hotspot, Internet and Wireless Fidelity.**

I. INTRODUCTION

A wireless network enables people to communicate and access applications and information without wires. Wireless Network have been around for many years.

Of course, cell phones are also a type of wireless communication and are popular today for people talking to each other worldwide. As with networks based on wire, or optical fiber, wireless networks convey information between computer devices [1]. A Wi-Fi hotspot is created by installing an access point to internet connection. Access point acts as a base station. When Wi-Fi enabled device encounters, a hotspot the device can then connect to that network wirelessly. A single access point can support up to 30 users and can function within a range of 100 up to 300 feet. Many access points can be connected to each other via Ethernet cables to create a single large network.

Gi-Fi is a wireless transmission system which is ten times faster than Wi-Fi and it's chip delivers short range multi gigabit data transfer in an indoor environment. Gi-Fi or gigabit wireless refers to a wireless communication at a data rate of more than one billion bits (gigabit) per second. GI-Fi is the world's first transceiver integrated on a single chip that operate at 60GHz on the CMOS process.

It will allow wireless transfer of audio and video data at up to 5 gigabits per second, ten times the current maximum wireless transfer rate, at one-tenth the cost [2]. National Information and Communications Technology Research Centre (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 as shown in Table 1.

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. The "Gi-Fi" was unveiled today at the Melbourne University-based laboratories of NICTA, (National Information and Communications Technology Research Centre), Australia. Professor Stan Skafidas said his team was the first to demonstrate a working transceiver-on-a-chip that uses CMOS technology - the cheap, ubiquitous technique that prints silicon chips [3]. This means his team is ahead and stood in front of the competition in terms of price and power demand.

Individuals, professionals and academics have learned to rely on computer networks for capabilities such as electronic mail and access to remote databases for research and communication purposes. Networking has thus become an increasingly pervasive, worldwide reality because it is fast, efficient, reliable and effective. Just how all this information is transmitted, stored, categorized and accessed remains a mystery to the average computer user. The Network evolution is hereby shown in fig.1 [4] below.

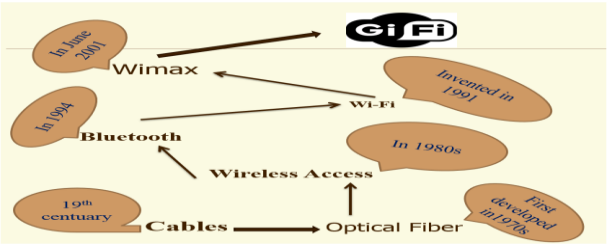

Fig. 1.0. Network Evolution.

Table 1: Comparison of existing wireless technology

Characters	Bluetooth	Wi-Fi	WiMax	Gi-Fi
Start date	1998	1990		2004
Transfer rate of data	800Kbps	11Mbps	1Gbps	5Gbps
Operating Frequency	2.4GHz	2.4GHz	2.3-3.5GHz	57-64GHz
Range	10m	100m	50km	10m
IEEE standard	IEEE 802.15	IEEE 802.11	IEEE 802.16	IEEE 802.15.3C
Power consumption	5mW	10mW	~5mW	<2mW
Authorize	Bluetooth SIG	IEEE WECA	WiMax	NICTA
Primary device	Industrial automation devices, PDAs,	Desktop, computers, notebook	Home devices, mobile phones,	Home devices, mobile phones,

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	mobile phones,		Electronic offices	Electronic offices in industrial automation devices

II. Wi-Fi

Basic concept is same as Walkie talkies. A Wi-Fi hotspot is created by installing an access point to internet connection. Access point acts as a base station. When Wi-Fi enabled device encounters a hotspot the device can then connect to that network wirelessly [8]. A Single access point can support up to 30 users and can function within a range of 100-150 feet indoors and up to 300 feet outdoors [8] as shown by fig, 2. Many access points can be connected to each other via Ethernet cables to create a single large network.

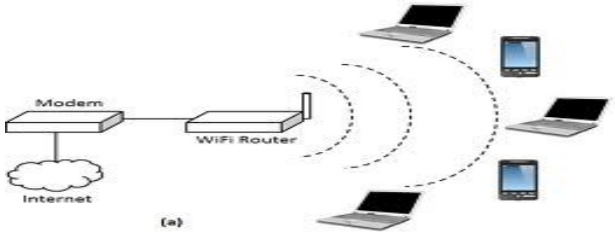

Fig. 2.0 Wi-Fi Configuration.

A. *Elements of a Wi-Fi Network*

- Access Point (AP): The AP is a wireless LAN transceiver or "base station" that can connect one or many wireless devices simultaneously to the Internet.
- Wi-Fi cards: They accept the wireless signals and relay information. They can be internal and external.
- Safeguards: Firewalls and anti-virus software protect networks from uninvited users and keep information secure.

B. *Wi-Fi Standards*

The wireless standards used by Wi-Fi is the IEEE 802.It covers the physical layer specification of technologies ranging from Ethernet to wireless IEE 802. The common know standards in 802 are 802.3 for Ethernet and 802.11 for Wi-Fi and 802.15 for Bluetooth. All the 802.11 specifications used the Ethernet protocol and carrier senses multiple access with collision avoidance (CSMA/CA) for path sharing. The original modulation used in 802.11 was Phase-Shift Keying (PSK). Nevertheless, some of the new modulation methods provide higher data speed and reduced vulnerability to interference. 802.11 are further expanded to 802.11a, 802.11b, and 802.11g etc. Ordinary 802.11 wireless product are too slow for most applications.

C. *Advantages and Disadvantages of Wi-Fi*

➢ ADVANTAGES OF Wi-Fi

 CONVENIENCE

The wireless nature of such networks allows users to access network resources from nearly any convenient location within their primary networking environment (a home or office). With the increasing saturation of laptop-style computers, this is particularly relevant.

 MOBILITY

With the emergence of public wireless networks, users can access the internet even outside their normal work environment. Most chain coffee shops, for example, offer their customers a wireless connection to the internet at little or no cost.

 PRODUCTIVITY

Users connected to a wireless network can maintain a nearly constant affiliation with their desired network as they move from place to place. For a business, this implies that an employee can potentially be more productive as his or her work can be accomplished from any convenient location.

 DEPLOYMENT

Initial setup of an infrastructure-based wireless network requires little more than a single access point. Wired networks, on the other hand, have the additional cost and complexity of actual physical cables being run to numerous locations (which can even be impossible for hard-to-reach locations within a building).

 EXPANDABILITY

Wireless networks can serve a suddenly-increased number of clients with the existing equipment. In a wired network, additional clients would require additional wiring.

 COST

Wireless networking hardware is at worst a modest increase from wired counterparts. This potentially increased cost is almost always more than outweighed by the savings in cost and labor associated to running physical cables.

For a given networking situation, wireless LANs may not be desirable for a number of reasons. Most of these have to do with the inherent limitations of the technology.

➢ DISADVANTAGES OF Wi-Fi

 SECURITY

To combat this consideration, wireless networks may choose to utilize some of the various encryption technologies available. Some of the more commonly utilized encryption methods, however, are known to have weaknesses that a dedicated adversary can compromise.

 RANGE

The typical range of a common 802.11g network with standard equipment is on the order of tens of meters. While sufficient for a typical home, it will be insufficient in a larger structure. To obtain additional range, repeaters or additional access points will have to be purchased. Costs for these items can add up quickly.

 RELIABILITY

Like any radio frequency transmission, wireless networking signals are subject to a wide variety of interference, as well as complex propagation effects that are beyond the control of the network administrator.

 SPEED

The speed on most wireless networks (typically 1-54 Mbps) is far slower than even the slowest common wired networks (100Mbps up to several Gbps). However, in specialized environments, the throughput of a wired network might be necessary.

III. Gi-Fi

Gi-Fi is operating at 60 GHz. Here we will use millimeter

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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). For this reason, 60GHz is an excellent choice for covert communication. Gi-Fi is the world's first transceiver integrated on a single chip that operates at 60 GHz on the CMOS [6].

Gi-Fi (Gigabits Fidelity or Gigabit Wireless) is similar to Wi-Fi but it has data rate ten times higher than the present highest wireless transmission rate and at a very low cost (i.e. one-tenth of the cost) and it satisfies the standards of IEEE 802.15.3C [7]. Gi-Fi was developed by researchers in Melbourne University, Australia, as the first transceiver fabricated on a chip with the help of the CMOS (complementary metal oxide semiconductor) process. The single chip measures about 5mm^2 chip with 1mm antenna operating at a frequency of 60 GHz that consumes power of about 2 milliwatt or less during its operation (see Fig 3). The Gi-Fi wireless technology is known have data rate of more than one Terabits (i.e. one billion bits) per seconds. NICTA (National ICT Australia Limited) research team choose 57-64GHz unlicensed frequency band for this technology therefore the speed of Gi-Fi can be up to 5 Gbps for transfer of large videos and other information wirelessly within fractions of seconds within indoor environment – usually within a 10 meter [7] [8]. Gi-Fi can be used as mobile data backhaul through which 3G and 4G networks providers can offload some of the data, especially in major cities where mobile network heavy traffic experience heavy congestion [8].

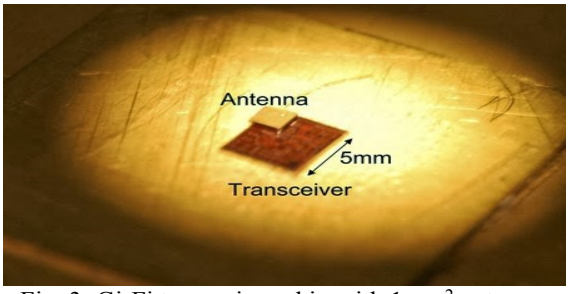

Fig. 3. Gi-Fi transceiver chip with 1mm^2 antenna.

D. *Working Principle of Gi-Fi Network*

In this we will use time division duplex for both transmission and receiving. Here data files are up converted from IF range to RF60 GHz 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 centered 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 [5]. 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. Time division duplex has a strong advantage in the case where the asymmetry of the uplink and downlink data speed is variable. As uplink traffic increases, more channel capacity can dynamically be allocated to that, and as it shrinks it can be taken away.

E. *Gi-Fi Technologies and Applications*

Gi-Fi technology is designed with IEEE 802.15.3C standard used for small antenna mounted on the roof where the subscriber station is located. The subscriber station is the central point of a Gi-Fi technology that can easily be accessed because it is located at different points. It has a wireless PAN used for transmissions among devices close to a person. It also supports Line-of-Sight operation since it can be mounted on the root. Gi-Fi Technologies is as follows

➢ *Time Duplex Division*

Gi-Fi technology uses TDD (Time Division duplex) for transmitting and receiving files (data). The time division duplex is used to separate incoming and outgoing signals. The uplink and downlink are assigned different time slots in the same frequency range, which allows more channel capacity and at different speed range. TDD emulates the full duplex communication link over the half duplex one. Stream of data are divided into frames and allocated different time to transmit and receive the signal, thereby TDD allows sharing of the same transmission medium [9].

➢ *The 60GHz*

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. Due to the demand of bandwidth and scarcity of frequency spectrum, there is focus on previous unoccupied portion of the frequency spectrum 40GHz to 300GHz (millimetre wave frequency). The 60GHz millimeter wave spectrum (un--licensed band) for data transfer is rarely used by other wireless technologies which has advantage of un-crowded. Because the antenna is linear in nature with unlined band, that makes it easy to achieve high rate of energy propagation. In unlicensed band, energy propagation has unique characteristics that provide additional benefits such as excellent immunity to co-channel interference, high security and frequency reuse. The 60GHz has high security, frequency re-usage and immunity to interference from co-channel. It can also be used for satellite-to-satellite communications for several years because it consumes high frequency which makes signals or transmission not to travel a far distance [9].

➢ *Beam forming*

Gi-Fi also uses MIMO technology which takes advantage of the fact that signals take multiple paths to their designation [10]. Beam forming ensure the incoming signals are directed properly using the most appropriate beam. The Gi-Fi specification uses adaptive beam forming to overcome the problem of higher propagation loss (usually in 2.5 GHz & 5GHz bands) by directing the beam in the exact direction needed, and it can be done in real time. Beam forming uses directional antennas to reduce interference and to concentrate the signal between two users

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at distances greater than 10m. This allows faster data transmission over longer distances.

➢ *Multi-band Operation*

Gi-Fi has spectrum flexibility such that a communication session can be rapidly and seamlessly transferred between a 60GHz channel and any lower-frequency Wi-Fi channel, including channels in the 2.4 GHz or 5GHz. This innovation enables seamless fall back to 2.4 GHz or 5 GHz Wi-Fi if 60 GHz Gi-Fi connectivity is not available. Multi - band operation provides a greatly improved user experience. Users with multi - band devices will be able to continue accessing the network, without interruption, if their device switches from a 60 GHz to a lower-frequency Wi-Fi channel

➢ *Transmission Link*

During the uplink transmission, data files are changed from IF range to RF60GHz (normal Gi-Fi range) with the aid of two mixers which is fed to the millimetre wave antenna through a power amplifier feeds. While the downlink process involve converting the incoming RF signal first to IF signal at 5Hz and then changed to normal data range. In this case, heterodyne construction is used to avoid leakage due to direct conversion thus high data transfer is achieved within seconds [10].

Application of Gi-Fi Technology includes Homes and offices appliances, Wireless pan network, inter-vehicle communication system, AD hoc information distribution, media access control (MAC), imaging, video information transfer, & other applications

B. *Gi-Fi Features*

- Small size: small chip size of 5*5mm with a tiny antenna of 1mm.
- High speed in data transmission: a speed of 5Gbps – ten times faster than other wireless technologies.
- Reduced power consumption: the lowest consumption power of 2mW to transfer huge amount of information.
- Frequency: The Gi-Fi technology operates at a fast frequency band of 60GHz (57-64GHz unlicensed frequency band)
- Highly portable and secured: IEEE 802.15.3C standard has good security features.

C. *Advantages of Gi-Fi*

✓ Low cost and portable
✓ Faster data transmission
✓ Low power consumption
✓ Internet infrastructure is not a necessity for data transfer.

D. *Disadvantages of Gi-Fi*

❖ Gi-Fi is restricted to shorter distance when compare to Wi-Fi technology and since it is a new technology, there is lack of skilled people who can deploy the technology

IV. Differences Between Wi-Fi & Gi-Fi

Table 2.0 summarizes the main differences between Wi-Fi and Gi-Fi wireless technologies. Each protocol between Wi-Fi and Gi-Fi is based on an IEEE & NICTA standard. Wi-Fi is oriented to WLAN (about 100m) while for Gi-Fi is embedded in devices (about 10m).

Table 2.0 Comparison between Wifi and Gifi.

Characteristics	Wi-fi	Gi-fi
Frequency	2.4 GHz; 5 GHz	57-64 GHZ
Range	100 meters	10 meters
Development Start date	1990	2004
Specification Authority	IEEE, WECA	NICTA
Primary Application	WLAN Ethernet	Embedded in devices
Data Transfer Rate	11 Mbps	5 Giga bps
Power Consumption	10 m W (milli watts)	< 2 m W (milli watts)
Primary Devices	Notebooks, desktop computer, servers	Mobile phones, Home devices, industrial Automation Devices
Primary Users	Enterprise users	Wireless Homes & Offices appliances
Usage Location	Within Range of WLAN infrastructure, usually inside a building	WPAN Networks

V. Conclusion

Wi-Fi is a simple cost-effective way to connect to the internet, without the need of physically connecting wires.

Within five years, we expect Gi-Fi to be the dominant technology for wireless networking. By that time, it will be able to provide services with low-cost, high broadband access and with very high speed large files swapped within seconds that are used in wireless home and office of future. If the success of Wi-Fi and the imminent wide usage of WiMAX is any indication, Gi-Fi potentially can bring wireless broadband to the enterprise in an entirely new way. Without doubt, Gi-Fi wireless technology represents a considerable improvement if compared to the existing technology and it will be the wireless technologies used in few years to come.

The comparison performed between Gi-Fi and existing wireless technologies in this paper shows that these features along with some other benefits that make it suitable to replace the existing wireless technologies. It removes cables that for many years ruled over the world and provides high speed data transfer rate. Gi-Fi technology has much number of applications and can be used in many places and devices such as smart phones, wireless pan networks, media access control. But when we follow the availability of facilities, price, operating system by the users, complexity-the Gigabyte Technology is not suitable for the common users.

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